Volume XLII Number 3

ANNALS

OF

The Entomological Society of America

SEPTEMBER, 1949

HERBERT OSBORN, *Editor Emeritus*
CLARENCE H. KENNEDY, *Editor Emeritus*

EDITORIAL BOARD

MAURICE T. JAMES, Managing Editor,
PULLMAN, WASHINGTON

1949	1950	1951
D. J. BORROR, COLUMBUS, OHIO.	C. D. MICHENER, LAWRENCE, KANSAS.	A. GLENN RICHARDS, ST. PAUL, MINN.
PHILIP GARMAN, NEW HAVEN, CONN.	C. W. SABROSKY, WASHINGTON, D. C.	STANLEY FREEBORN, BERKELEY, CALIF.
F. H. BUTT, ITHACA, N. Y.	M. W. SANDERSON, URBANA, ILL.	WILLIAM C. COOK, WALLA WALLA, WASH.

PUBLISHED QUARTERLY BY THE SOCIETY
COLUMBUS, OHIO

Entered as second-class matter April 11, 1908, at the Post Office at Columbus, Ohio, under the act of Congress of March 3, 1879. Subject to rate of postage provided for in Paragraph 4, Section 538, P. L. & R., authorized September 16, 1940.

The Entomological Society of America

Founded 1906

OFFICERS, 1949

President

ALVAH PETERSON . . . . . Columbus, Ohio

First Vice-President

A. GLENN RICHARDS . . . . . St. Paul, Minnesota

Second Vice-President

PAUL O. RITCHER . . . . . Lexington, Kentucky

Secretary-Treasurer

HERBERT H. ROSS . . . . . Urbana, Illinois

Managing Editor Annals

MAURICE T. JAMES . . . . . Pullman, Washington

Executive Committee

THE OFFICERS

AND

1949	1950	1951
J. FRANKLIN YEAGER		E. G. LINSLEY
A. GLENN RICHARDS		O. E. TAUBER

NOTE: 1950 members of Executive Committee not available.

Thomas Say Foundation

J. J. DAVIS, *Editor and Treasurer*

1949	1950
C. F. W. MUESEBECK	E. S. ROSS
HERBERT H. ROSS	C. E. MICKEL

ANNALS
OF
The Entomological Society of America

Volume XLII SEPTEMBER, 1949 No. 3

A STUDY OF THE PTILINUM AND PTILINAL MUSCULATURE OF THE POMACE FLY, DROSOPHILA MELANOGASTER MEIGEN[1]

(Diptera, Drosophilidae)

E. LAURENCE ATKINS, JR.
Citrus Experiment Station, Riverside, California

INTRODUCTION

The pomace fly, *Drosophila melanogaster* Meigen, is one of the flies of the group Cyclorrhapha and suborder Schizophora which in the pupal stage possesses on the cephalic aspect of the head an extensive membranous organ or frontal sac, the ptilinum. It serves by its alternate distension and contraction to rupture the puparium and assist in the emergence of the imago. After emergence the ptilinum is permanently retracted as an invagination within the head capsule. Although the function of the ptilinum has been known since it was first described by Réaumur (1738), it is not known, to the author's knowledge, whether the failure of the adults to emerge from the puparia, in lethal flies, is dependent upon the failure of the ptilinum to function or upon some other cause. This research was instigated to determine the role of the ptilinum and attached muscles in the emergence of the normal flies. The author hopes to make a study of the lethal flies at a later time.

The investigation was conducted at the suggestion of Dr. W. M. Luce, Assistant Professor of Zoology at the University of Illinois who has assisted throughout the work. The author wishes to express his sincere thanks to Professor Luce for his encouragement and help and to Dr. William P. Hayes, Professor of Entomology, for his critical reading of the manuscript.

REVIEW OF THE LITERATURE

Very little work has been done on the function, muscles, and histology of the ptilinum of the ptilinal-bearing Diptera since Réaumur's original description. Most of this work has been on the ptilinum of the blow fly, *Calliphora erythrocephala* (Meigen).

[1]Contribution No. 281 from the Department of Entomology of the University of Illinois.

Knab (1911) gave a short review of the literature concerning the emergence of cyclorrhaphous flies from their puparia. According to this review, Joly (1846) pointed out that the inflation of the ptilinum took place by blood-pressure and not by air-pressure as Réaumur suggested in 1738. Künckel d'Herculais (1875) stated that an apparent ptilinal mechanism was to be found in the syrphids (*Syrphus*, *Volucella*, and *Eristalis*), but he was wrong in that this was not a true ptilinum but was caused by the expansion of the genal areas during eclosion—a phenomenon found also in *D. melanogaster*. Laing (1935) states in her review of the literature that Lowne (1890–92) was the only one before her who gave an account of the muscle supply of the ptilinum. Both Lowne and Laing worked on the blow fly.

Wahl (1915) and Laing (*l.c.*) are the only ones who have discussed the development of the ptilinum. Wahl (*l.c.*) stated that the mesocaudal portion of the frontal sac migrates to the anterior end of the pupa and later becomes reinvaginated, becoming the ptilinum. The frontal sac is the cephalic portion which bears the imaginal discs of the antennae and compound eyes which, when invaginated, form the head of the imago. Laing further elaborated on the development of the ptilinum in her work.

Robertson (1936) thoroughly studied the mechanism of metamorphosis of the larva during the third, fourth (or prepupal) instars, and the pupal stage. He stated that during the quiescent fourth larval instar the larva becomes loosened from the puparium, and a large gaseous bubble is formed within the body during this prepupal period. At the end of this stadium, it pupates, shedding the prepupal or fourth instar cuticle. The gas bubble is used to separate the cuticle from its hypodermis. Practically all of the tissues undergo change and are replaced by imaginal structures derived from specialized cells, the imaginal buds. Some of the muscles persist longer than the general mass and perform special functions in the pupa.

MATERIAL AND TECHNIQUE

Material.—The parent flies[2] were placed in four dram vials containing food and allowed to remain for four hours to enable the females to deposit all eggs which might have been held in the oviducts until a suitable place for oviposition was available. In this way eggs of about the same degree of development were obtained for study. The parent flies were then transferred to fresh vials of food and allowed to oviposit for one hour and were again transferred to fresh vials. These eggs were then allowed to hatch and to develop until the larvae and pupae were removed from the vials to be killed and fixed. The adults were removed as they emerged and placed in groups of 10 to 20 in vials with fresh food and were killed when the desired ages were reached. The food consisted of water, agar-agar, dehydrated yeast, corn meal, and molasses. The flies were raised in a controlled temperature room at a constant temperature of 21.5° C. and 69 percent relative humidity.

[2]The flies used in this study are from the wildtype +1119.1 known as "Luce's Wild Stock," which has been maintained in the laboratories of the University of Illinois for over thirty years.

Technique.—The larvae were killed, fixed, and sectioned, at 120 hours after hatching, which was 12 to 14 hours before pupation; at 126 hours, after the larvae had crawled up out of the food to pupate; at 134 hours, at which time the anterior spiracles had everted, and the flies had entered the prepupal period which lasted about 30 hours at 21–22° C.; at 144 hours; at 158 hours which was just before the commencement of the true pupal stage when the imaginal buds of the head become everted; and at 24 hour periods thereafter until the emergence of the adults, which occurred at approximately 102 hours after pupation.

The adults were killed, fixed, and sectioned at periods of 30 minutes after emergence; 2 hours; 12 hours; 24 hours; and then at 24 hour periods up to 10 days after emergence. No flies over 10 days old were studied.

The specimens were killed by immersion in boiling water for 5 minutes, fixed for from 12 to 24 hours in a cold solution of a modified Bouin's solution[3] which imparts a yellow stain which is useful later in

1 per cent picric acid in 95 per cent alcohol	180 cc.
Chloroform	30 cc.
Glacial acetic acid	15 cc.

orientating specimens in the paraffin blocks, dehydrated in ascending grades of alcohol beginning at 70 percent for two hours duration to absolute, 50–50 solution of absolute alcohol-cedarwood oil,[4] two changes of cedarwood oil, two changes of melted paraffin, and embedded in paraffin. Sections were cut at 10 microns thickness and fixed to slides with Haupt's adhesive and anhydrated in descending grades of alcohol to distilled water. The picric acid was removed by lithium carbonate, a saturated solution, in 70 percent alcohol. Mordanting was accomplished with a 5 percent solution of iron-alum, washed, and stained 12 hours with Heidenhain's hematoxylin and destained with a 1 percent solution of iron-alum to the desired intensity. Then they were redehydrated and mounted in balsam.

Dissections of the heads of imagines in glycerine under a binocular microscope, the ptilinum distended, gave valuable preparations for the study of the musculature.

DEVELOPMENT OF THE PTILINUM

In larvae 120 hours old[5] the frontal sac, which represents the developing imaginal head complex, that is, the compound eyes, the antennae, and the ptilinum, is quite small and not as yet everted. Chen (1929) gives an accurate description and explanation of the cephalic complex in the larval stages, but he and other authors have failed to trace the development of the ptilinum. The ptilinum cannot be actually pointed out until after the two lateral lobes of the frontal

[3]The formalin in Bouin's solution was replaced with chloroform to prevent the hardening effect of formalin upon chitin. The modified fixing solution formula used was as follows:

[4]Cedarwood oil was substituted for xylol to prevent excess hardening of the chitin previous to sectioning (Eltringham, 1930).

[5]Specimens reared at 21.5° C. and 69 percent relative humidity and upon the food used in this study showed an extended larval period of 30 hours and an extended pupal period of 6 hours over those reared by other authors at 25° C.

sac have fused mesally and have become hollow. The frontal sac continues to become enlarged in 126 hour larvae which have crawled up on the sides of the vials and have become quiescent prior to pupation.

At the time of pupation (when the anterior spiracles have become evaginated from the puparium) the frontal sac has become quite enlarged, and the ptilinal region of 6-hour prepupae appears as a vague thickened cellular area above the differentiated antennae. In 16-hour pupae the antennal fossa is evident as a separate area.

Somewhere between the twenty-fourth and thirtieth hours at 21.5° C. the developing pupa separates from the fourth larval integument, and the forcible eversion of the frontal sac takes place, indicating the commencement of the true pupal stage. Some of the muscle strands are just beginning to become evident as very obscure thin strands of tissue.

It is not until around 54 hours after pupation that the ptilinum is plainly apparent as a definite spinuleless region of dividing cells. The ptilinal area at this time is partially invaginated in most specimens. The transverse-vertex muscle is now clearly visible on the vertex, and the transverse-ptilinal muscle is also just forming. The post-occipital-proboscal muscle and the ptilino-pharyngeal muscles are just forming. In the 78-hour pupae the ptilinum has continued to gradually become almost fully invaginated with its continual development, and by this time the ptilinum already bears cuticular spinules. The developing muscles, attached to its surface, are represented by linear chains of nuclei surrounded by a small amount of unstriated cytoplasm.

At 102 hours the ptilinum is usually fully evaginated and pulsations are often apparent. As the surface of the ptilinum increases, its thickness gradually decreases, the increased area of the ptilinal membrane accommodating itself by becoming enfolded and crumpled as it invaginates within the head. At this time the organ is completely developed, and the cuticle has become greatly thickened, and the epidermis has been reduced to an attenuated layer.

THE PTILINUM AND PTILINAL MUSCULATURE

The bulk of the ptilinal membrane lies between the mesocaudal limits of the vertex and the bases of the antennae and lunule. However, a narrower extension of the ptilinal membrane also passes ventrad on each side between the fronto-clypeus and the genae, the full length of the ptilinal or frontal suture. After emergence from the puparium is effected, the whole region of the ptilinum is permanently invaginated within the head capsule, leaving as external evidence of its presence only a narrow invagination representing the ∩-shaped suture setting off the fronto-clypeus from the vertex and genae. The lunule is located on the fronto-clypeus just dorsad of the points of insertion of the antennae. It is a small cresent-shaped area of thickened cuticle forming the dorsal margin of the fronto-clypeus. It is naked and appears on the inflated ptilinum as a clear area located mesad above the antennae.

The structure of the ptilinum in the newly emerged imago is somewhat similar to the integument of the genae, vertex, and fronto-clypeus with which it is continuous. The major difference is that the spinules

which cover the surface of the ptilinal membrane are broadened at their bases and are not surrounded by a sclerotized ring as are the slender setae of the ectal surfaces of the head capsule. The spinules are about the same length as these setae but are somewhat stouter. All of the spinules of the ptilinal organ are of the same shape as is true in *Calliphora* as described by Laing. The ptilinum consists of a layer of cuticle 20 to 25 microns in thickness without pigment and staining lightly with the stain and is covered with spinules regularly arranged, is not stained with Heidenhain's haematoxylin. They have an average width at their bases of 20 microns and a height of 20 microns. The whole is secreted by a syncytial epidermis.

On the entral surface of the ptilinal membrane are the insertions of certain muscles, all of which function only as retractors of the organ during and after emergence of the imago. These muscles are as follows:

Transverse-ptilinal muscle (figs. 4 and 7, *t.p.*).—These are the "compressors" of Lowne (*l.c.*). The fibers extend horizontally across the cavity caudad of the ptilinum and have a dorso-ventral attachment with the membrane near the adjacent laterocaudal projections of the vertex. This bundle of muscle fibers is attached in a central position on the broad region of the ptilinal membrane and is about 50 microns deep and 20 microns wide. When the ptilinum is invaginated, the muscle forms a compact mass over its ental surface. It functions as a compressor of the ptilinal membrane after each distension pulsation and to permanently invaginate the ptilinal membrane after emergence. The transverse-ptilinal muscle appears to be just forming in 30-hour pupae at 21.5° C. and 69 percent relative humidity and is functional in 54-hour pupae. It is retained until after emergence but is completely lost before the imago is 12 hours old. Only traces of this muscle are to be found in many of the imagines two hours old.

Ptilino-pharyngeal muscle (fig. 8, *p.p.*).—This muscle arises from the cornua of the basipharynx and holds the oesophagus between the cornua since the muscle is an unbroken sheet up to the point where it forks to attach to the cornua or "fulcrum" of Laing. It has a wide base of insertion on the most anterior region of the inflated ptilinum in a narrow band of wide lateral extent. Laing (*l.c.*) terms this muscle the "ptilino-oesophageal muscle," and according to her these are the fibers termed "retractors of the fulcrum" by Lowne, "retractors of the oesophagus" by Graham-Smith (1930), "and muscle ptilino-pharyngien" or "m. retractor ptiline" by Mercier and Villeneuver (1925). The author's own observations corroborate the opinions of Laing and of Mercier and Villeneuve in indicating that this muscle plays an important role in the retraction of the ptilinum. Mercier and Villeneuve further supposed that after invagination of the ptilinum the ptilino-pharyngeal muscle played the role of pharyngeal dilator. Since, however, from sections of imagines over 12 hours old all traces of this muscle are absent, the present author agrees with Laing's work on *Calliphora* that the only function of the ptilino-pharyngeal muscle is the retraction of the ptilinum. The ptilino-pharyngeal muscle was first found in 30-hour pupae (fig. 2, *p.p.*) and was lost 12 hours after emergence.

Ptilino-tentorial muscles (fig. 9, *p.t.m.*).—These are paired muscles which are similar to those found by Laing in *Calliphora*. They arise

from short tendons which are attached to the body of the tentorium at its lateral junction with the border of the occipital foramen (fig. 10, *p.t.m.*). They are inserted on the ptilinum at each side dorso-laterally as a narrow band immediately in front of the line of demarcation between the vertex and the ptilinum. Laing (*l.c.*) states that these muscles are homologous with Lowne's large fan-shaped retractors and aid in retracting and invaginating the ptilinum. In 78-hour pupae the ptilino-tentorial muscles are just forming and persist until they are completely dissipated in 20-hour imagines.

THE MUSCULATURE ASSOCIATED WITH THE PTILINUM

Although not inserted on the ptilinal membrane, there are in the head capsule seven other groups of muscle fibers which apparently are associated with the ptilinum and other parts of the head during emergence. These are as follows:

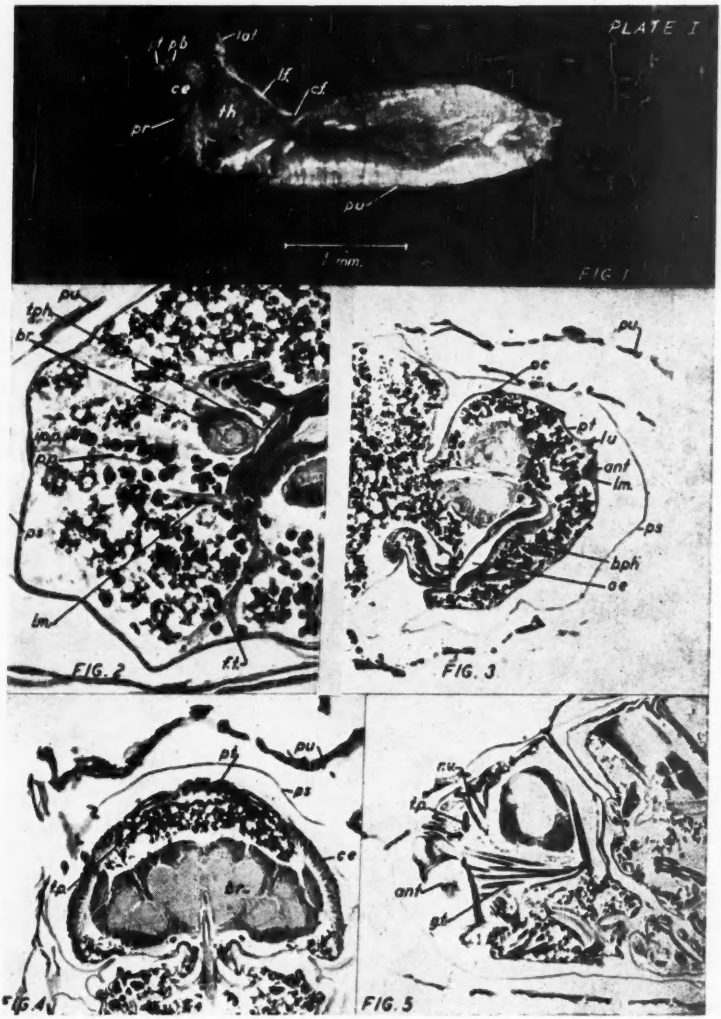
Geno-tentorial muscles (figs. 5, 6, 10, and 11, *g.t.*).—These muscle-fibers arise from the same tendons as the ptilino-tentorial muscles (fig. 10, *p.t.m.*) and also from the occipital sclerotized thickenings which mark off the occipital sclerites. They are inserted over a wide dorsoventral area on each gena between the compound eyes and the frontal suture. According to Laing the contraction of these muscles results in the approximation of the genal and occipital regions and when heamolymph is being withdrawn into the abdomen, returns the shape of the head to normal. When the head is distended with haemolymph, the contraction of these muscles appears to result in the flattening of the genae. Haemolymph is thus forced forward into the ptilinum which is thereby rendered more turgid and helps in rupturing the puparium. These muscles are found forming in 54-hour pupae and have almost disappeared in 24-hour imagines.

Fronto-tentorial muscles (figs. 6, 10, and 11, *f.t.*).—This pair of muscles arises from the same tendons of the tentorium and occipital sclerites though more centrally than the geno-tentorial muscles (figs. 6, 10, and 11, *g.t.*), and are inserted in large dorsoventral groups on the

---

ABBREVIATIONS USED ON PLATES

ant.... antenna
bph.... basipharynx
br..... brain; supra- and sub-oesophageal ganglia
ce..... compound eye
c.f..... circular fissure of puparium
cr..... cornua
f.t..... fronto-tentorial muscle
g.t..... geno-tentorial muscle
i.p.p... insertion of ptilino-pharyngeal muscle on ptilinum
lat..... larval anterior spiracle
l.f..... longitudinal fissure of puparium
l.m.... lunular muscle
lu..... lunule
mxp.... maxillary palpus
oc..... ocellus
oe..... oesophagus
pb..... boundary between ptilinum and vertex
p.p..... ptilino-pharyngeal muscle
pr..... proboscis
ps..... pupal sheath; fourth larval integument
pt..... ptilinum
p.t.m.. ptilino-tentorial muscles
pu..... puparium
r.a..... oculo-antennal muscles—retractors of the antennae
r.v..... fronto-pharyngeal muscles—retractors of the vertex
t..... tentorium
th..... thorax
t.p..... transverse-ptilinal muscle
t.ph.... tentorio-pharyngeal muscle
t.v..... transverse-vertex muscles



EXPLANATION OF PLATE I

FIG. 1. Microphotograph of lateral aspect of the pomace fly, *Drosophila melanogaster* Meigen, in the act of emergence. FIG. 2. Microphotograph of sagittal section of head of 30-hour pupa showing oesophagus passing through the supra- and sub-oesophageal ganglia of brain. FIG. 3. Microphotograph of sagittal section of head of 54-hour pupa. FIG. 4. Microphotograph of dorso-ventral section of head of 78-hour pupa. FIG. 5. Microphotograph of sagittal section of head of 102-hour pupa.

lateral margins of the fronto-clypeus. They are not concentrated in one area just below the bases of the antennae in *D. melanogaster* as Laing has described for *Calliphora*. Contraction of these muscles also results in diminution of the volume of the head as do the genotentorial muscles. These muscles are found forming in 30-hour pupae (fig. 2, *f.t.*) and persist until they disappear shortly after the seventy-second hour in imagines.

Transverse-vertex muscles (fig. 8, *t.v.*).—This muscular layer lies underneath the integument of the vertex immediately caudad of the greatly thickened mesal part of the frontal suture and extending transversely between the compound eyes. The contraction of this muscle layer diminishes the volume of the head. This muscle appears first in 30-hour pupae and is almost entirely gone in two-hour imagines.

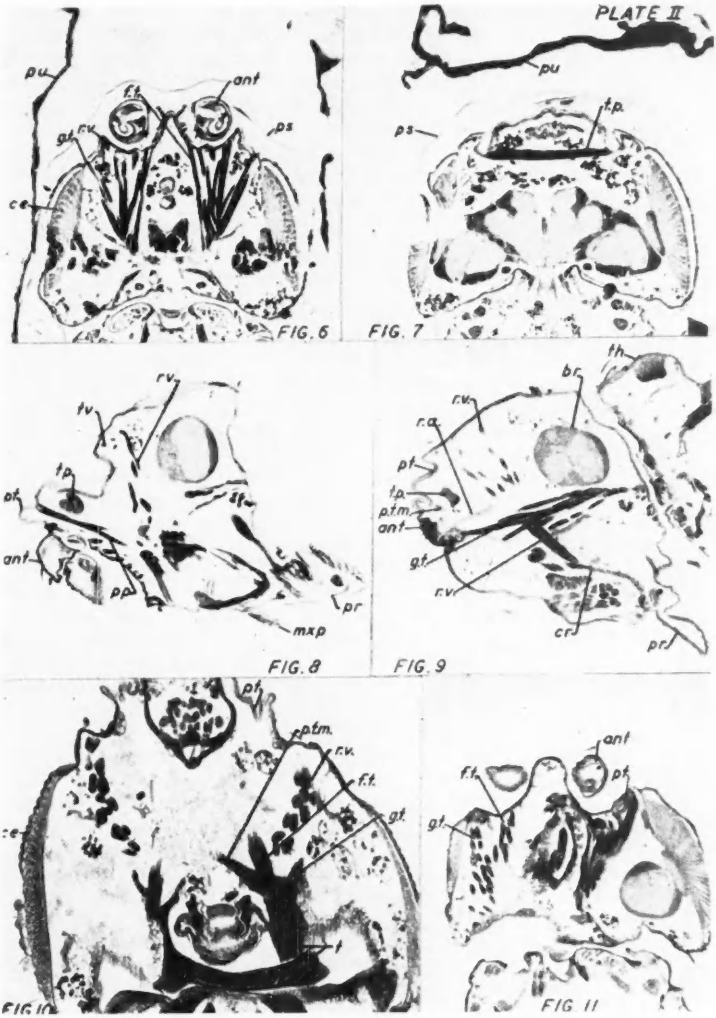
Lunular muscle (figs. 2 and 3, *l.m.*).—Jobling (1933) described this muscle in *Glossina* under the name "retractors of the fronto-clypeus," and it seems to be quite similar in *Glossina*, *Calliphora*, and *Drosophila* in that it is an unpaired, long, thin muscle arising from the dorsal rim of the occipital foramen. It passes between the supra- and sub-oesophageal ganglia and is attached to the lunule of the fronto-clypeus dorsad of the antennal bases close to the caudal edge of the ptilinal or frontal suture. It retracts the fronto-clypeus and the ptilinum after emergence. It first appears in 30-hour pupae (fig. 2, *l.m.*) and persists after emergence beyond 10-day old imagines without any apparent deterioration. Its function in the imagines after emergence is not known.

Oculo-antennal muscles (fig. 9, *r.a.*).—These are the "retractors of the antennae" of Jobling (*l.c.*) who states that this pair of muscles arises from the lateral margins of the vertex and passes through the scape, the first antennal segment, and becomes inserted on a short process of the dorsal part of the caudal region of the pedicle, the second antennal segment. In *D. melanogaster* this pair of muscles appears to be inserted on the ocular sclerites at the dorsocephalic margin of the compound eyes instead of on the vertex as in *Calliphora* and to be consistent in terminology should be termed the *oculo-antennal muscles*.

This pair of muscles assists in deflating the head during emergence by approximating the vertex and fronto-clypeus; subsequently, it functions only as the antennal retractors. They first appear in 54-hour pupae and persist until they are almost completely dissipated in 72-hour imagines.

Fronto-pharyngeal muscles (fig. 9, *r.v.*).—This pair of muscles is the "retractors of the vertex" of Laing (*l.c.*) and arises from the caudal surface of the cornua (fig. 9, *c.r.*) of the basipharnyx and is inserted partly on the ocular sclerites and partly on the lateral margins of the vertex caudad of the *oculo-antennal muscles*. These muscles appear to pull in the vertex during the deflation of the head. To be consistent in terminology, these muscles should be termed the *fronto-pharyngeal muscles*, the terminology which was used by Mercier and Villeneuve. These muscles appear to be just forming in 54-hour pupae and are being absorbed rapidly in 12-hour imagines.

Tentorio-pharyngeal muscles (fig. 2, *t.ph.*).—There is also an additional pair of muscles attached cephalad of the cornua of the basipharynx



EXPLANATION OF PLATE II

FIG. 6. Microphotograph of dorso-ventral section of head of 102-hour pupa. FIG. 7. Microphotograph of dorso-ventral section of head of 102-hour pupa. FIG. 8. Microphotograph of sagittal section of head of adult one-half hour after emergence. FIG. 9. Microphotograph of sagittal section of head of adult, one-half hour after emergence. FIG. 10. Microphotograph of cross-section of head of adult, one-half hour after emergence. FIG. 11. Microphotograph of dorso-ventral section of head of adult, two hours after emergence.

("fulcrum" of Laing and other authors) and are attached caudad of the tendons of the tentorium along with the ptilino-tentorial muscles. Since the basipharynx of the proboscis is movable, it seems that this set of "tentorio-pharyngeal muscles" is also necessary to aid the ptilino-pharyngeal muscles to retract the ptilinum during and after emergence of the imagines, and they are subsequently retained as retractors of the proboscis. This set of muscles is first seen in 30-hour pupae and persists at least through the 10-day old imagines and shows no evidence of being absorbed.

THE USE OF THE PTILINUM IN EFFECTING EMERGENCE OF THE IMAGINES FROM THE PUPARIA

The emergence of the imagines of *D. melanogaster* occurs much the same way as that described by Laing (*l.c.*) for *Calliphora*. Emergence occurs after a pupal period averaging 102 hours when reared at 21.5° C. and 69 percent relative humidity. The puparium is ruptured along two fissures—a longitudinal and a circular one (fig. 1, *l.f.* and *c.f.*). The longitudinal fissure extends around the cephalic end and along the sides, external to but in the same line as, the main tracheal trunk of the larva, until it meets the circular fissure which runs around only the laterodorsal portion of the cephalic margin of the fourth visible segment above the longitudinal fissure. The ruptured dorso-cephalic lid hinges back when forced open and never breaks off as in *Calliphora*. This rupturing is effected by the alternate inflation and retraction of the ptilinum, the resulting pulsation usually continuing regularly for from one-half to five minutes after emergence. The inflation is brought about by pressure of the haemolymph being forced into the head by contraction of the abdominal and thoracic regions. The whole head capsule including the proboscis becomes very much distended. The head is distended principally along the longitudinal axis, but then apparently by contraction of the geno-tentorial muscles and probably aided by the transverse-ptilinal muscle it becomes narrower laterad, especially after the edges of the longitudinal fissure have separated. The withdrawal of haemolymph from the head is probably effected by the relaxation of the abdominal and thoracic muscles and by contraction of the ptilinal and associated head musculature, and the ptilinum is invaginated by the contraction of the ptilinal and associated musculature as described earlier. The continued periodic inflation and distension of the ptilinal region and the head capsule probably facilitates the passage of the thorax and abdomen through the constricted opening of the puparium since the puparium does not rupture at its largest diameter.

The observed time of rhythmatic pulsations averaged three seconds in the inflated and one second in the deflated condition. The imagines usually took an average of one to three minutes to effect emergence under observation; however, the pulsations begin as early as 12 hours before rupturing of the puparium and last up to 10 minutes after emergence is completely effected. The setae and bristles on the body appear to prevent the imago from slipping back into the puparium during contraction and relaxation of the abdomen.

SUBSEQUENT CHANGES IN THE PTILINUM AND ASSOCIATED MUSCULATURE

The cuticula of the ptilinum in newly emerged flies is very similar in structure to that of the neighboring integument as was previously mentioned. In flies over 24 hours old, the cuticula of the vertex is fully hardened and pigmented and consists of an ectal, yellow, refractive layer, pilose externally, which is not stained with Heidenhain's haematoxylin and which contains pigment. There is also a thinner, less refractive, ental layer which stains readily and which represents the living hypodermal cell layer. However, the cuticula of the invaginated ptilinum is now becoming quite different. The ptilinal cuticula of the imago is two times as thick as the cuticula of the remainder of the head capsule until after the eighth day, at which time it becomes somewhat thinner. At this time it is composed only of an ectal layer which is less refractive, is but slightly stainable, and has no pigment. By the end of the tenth day in the imago the ptilinal integument is reduced to two-thirds the thickness of the integument of the head capsule. The infolded and invaginated ptilinal integument now consists of a thin layer which bears the spinules. The reduction in the thickness of the ptilinal integument is not so marked as in *Calliphora*. In Laing's work on *Calliphora* it is reduced to one fifth of the original thickness at emergence whereas in *D. melanogaster* it is reduced to one third of the original thickness at emergence.

At the end of 24 hours after emergence, all the muscles connected directly to the ptilinum have been completely absorbed. At the end of 96 hours all the muscles which are associated with retraction of the ptilinum have been completely absorbed with the exception of two sets. These are the lunular muscle (fig. 2, *l.m.*) and the tentorio-pharyngeal muscles (fig. 2, *t.ph.*). The lunular muscle has not degenerated and its subsequent function has not been determined since it serves as a retractor of the fronto-clypeus during emergence and since after emergence the fronto-clypeus remains fixed in relation to the remainder of the head capsule. The tentorio-pharnygeal muscles persist as retractors of the proboscis. Laing states that the retractors of the antennae (*oculo-antennal muscles*), (fig. 9, *r.a.*) persist in *Calliphora* after the second day but are non-functional. In *D. melanogaster*, however, the *oculo-antennal muscles* have completely disintegrated after 72 hours. The air sacs of the head become enlarged and distended after 24 hours, and as the muscles are lost, the space is filled with distended air-sacs limiting the space available for haemolymph.

Laing (*l.c.*) suggested that in *Calliphora* the degeneration of the ptilinal musculature was probably associated with the disuse of the muscles concerned and that the distension of the cephalic air sacs, resulting in cutting off much of the haemolymph supply, probably is significant in their degeneration. The author disagrees with Laing and suggests that since this degeneration takes place so rapidly in most instances in *D. melanogaster* that primarily degeneration is effected immediately upon cessation of the ptilinal pulsations by a release of histolytic enzymes from the nuclei of the muscles concerned. It would seem that this is true because if these enzymes were contained in the body fluid, all of the muscles, including the persisting proboscal musculature, would degenerate. There is no evidence in the imagines of

D. melanogaster that phagocytosis effects histolysis as in the pupal stage. This agrees with Laing's work since although phagocytes are present, they are not found in close relation to degenerating muscle-fibers.

DISCUSSION

Laing (*l.c.*) presents a thorough, comparative discussion of the origin and development of the ptilinum in the Diptera; therefore, the author will not rediscuss this work here.

The author agrees with Laing in that the ptilino-pharyngeal muscle has no function other than aiding in retracting the ptilinum since all traces of it disappears before 12 hours after adult emergence in *D. melanogaster*. It appears that Mercier and Villeneuve (*l.c.*) were in error in supposing that this muscle was retained as the pharyngeal dilator in the ptilinal-bearing Diptera after emergence is effected. However, the ptilino-pharyngeal muscle offers an interesting study in evolutionary changes in function. In the Nematocera (Culicidae, Knab, *l.c.*) this muscle acts as a pharyngeal dilator during emergence since by contraction of this muscle air is sucked into the alimentary canal and serves to distend the body and makes the body firmer. In the Aschiza (*Eristalis*, Becher, 1882) this muscle has little or no function since air in the alimentary canal is not used to aid in effecting emergence and since there is no ptilinum. In the Schizophora and in both the Acalyptratae and Calyptratae (*Drosophila* and *Calliphora*, respectively), a ptilinum is present, and in these instances this muscle acts only as a retractor of the ptilinum. So we can easily see that this muscle functions in three different ways in three groups of Diptera, acting in *D. melanogaster* as an aid only in the emergence of the imagines. All of the muscles mentioned in this work seem to be present almost solely for the purpose of effecting emergence of the imagines, with the exception of the lunular and the tentorio-pharyngeal muscles, since all of these muscles degenerate so rapidly.

SUMMARY

1. An account is given of the morphology, development, and changes of the ptilinum prior to, during, and following emergence of the pomace fly, *Drosophila melanogaster* Meigen.

2. The ptilinum develops from the integument of the cephalic portion of the frontal sac of the head region. Differentiation from the adjacent vertex, fronto-clypeus, and genae begins first as a local thickening of the epidermis. At the end of six hours after pupation at 21.5° C. and 69 percent relative humidity, this epidermal thickening grows inwardly, and as its surface area increases, its walls become gradually thinner. Rudiments of the ptilino-pharyngeal muscle are visible immediately after eversion of the head (in 30-hour pupae) at which time many of the other muscles appear. All ten sets of muscles discussed have appeared in 78-hour pupae.

3. In the freshly emerged fly the ptilinum is continuous with the integument of the vertex, fronto-clypeus, and genae. Two unpaired and one pair of retractor muscles are inserted on the ptilinum; seven other muscles apparently are used in connection with the pulsation of the head during emergence.

4. By rhythmatic expansion and contraction of the ptilinum,

the puparium and pupal sheath are ruptured, and emergence of the fly is effected. After final retraction of the ptilinum into the head capsule, no more use is apparently made of the organ.

5. In 10-day old adults the ptilinal integument is reduced to a layer of spinules. Before 48 hours have elapsed after emergence, practically all of the ptilinal and associated accessory muscles have disappeared. Their dissipation does not appear to be due to phagocytic activity. The author suggests that such rapid dissipation may possibly be due to the release of histolytic enzymes from the nuclei of the muscles concerned.

6. The evolution of functions of the ptilino-pharyngeal muscle is traced through the order Diptera. From the evidence brought forward it is suggested that the Nematocera, Aschiza, and Schizophora represent three independent lines of genetic development.

SELECTED REFERENCES

Becker, E. 1882. Zur Kenntniss der Kopfbildung der Dipteren. Wiener Entom. Zeitung, 1: 49–54.

*__Chen, Tse-yin.__ 1929. On the development of imaginal buds in normal and mutant *Drosophila melanogaster*. Journ. Morph., 47 (1): 135–200.

*__Eltringham, H.__ 1930. Histological methods for entomologists. Oxford, Clarendon Press, 1930, pp. 1–139.

Graham-Smith, G. S. 1913. Flies and disease: non-blood-sucking flies. Cambridge Univ. Press, 1914.

1916. Observations on the habits and parasites of common flies. Parasitology, 8: 440–554.

1930. Further observations on the anatomy and function of the proboscis of the blow-fly, *Calliphora erythocephala* L., Parasitology, 22: 47–115.

*__Jobling, B.__ 1933. A revision of the structure of the head, mouthparts, and salivary glands of *Glossina palpalpis* Rob.-Desv. Parasitology, 24(4): 449–490.

Joly, Nicolas. 1846. Recherches . . sur les oestrides, etc. Ann. sci. phys. et nat., agric. et indust. de Lyon, 9: 204.

*__Knab, F.__ 1911. On ecdysis in Diptera. Proc. Entom. Soc. Wash., 13: 32–42.

Kunckel d'Herculais, J. 1875. Recherches sur l'organisation et le développement des Volucelles. Paris, 1881, pp. 1–208, with atlas.

*__Laing, Joyce.__ 1935. On the ptilinum of the blow-fly (*Calliphora erythrocephala*). Quart. Journ. Micro. Sci., 77: 497–521.

*__Lowne, B. T.__ 1890–92. The anatomy, morphology, and development of the blow-fly, Vol. I, pp. 125–126. Porter, London.

Mercier, L., and **Villeneuve, J.** 1925. Contribution à l'étude de l'anatomie de la téte des dipteres. Cyclorrhaphes. La ptiline et le muscle ptilino-pharyngien. C. R. Acad. Sci. France, 181: 882–884.

1926. Deuxieme contribution à l'étude de l'anatomie de la téte des Dipteres Cyclorrhaphes. C. R. Acad. Sci. France, 182: 1098–1100.

1927. Les muscles gubernateurs de la lunule chez *Eristalis tenax* L., dimorphsime sexuel. C. R. Acad. Sci. France, 184: 299–301.

*__Poulson, D. F.__ 1937. The embryonic development of *Drosophila melanogaster*. Paris, 1937, pp. 1–51, 2 pls.

Réaumur, R. A. F. de. 1738. Memoires pour servir à l'histoire des insectes, Paris, Vol. 4, pp. 1–636, 44 fig.

*__Robertson, C. W.__ 1936. The metamorphosis of *Drosophila melanogaster*, including an accurately timed account of the principal morphological changes. Jour. Morph., 59: 351–400.

*__Snodgrass, R. E.__ 1924. Anatomy and metamorphosis of the apple maggot, *Rhagoletis pomonella* Walsh. Jour. Agr. Res., 28 (1): 1–36.

Wahl, B. 1915. Ueber die Kopfbildung cyclorrhapher Dipteren-larven u. die post-embryonale Entwicklung des Fliegenkopfes, Arb. Zool. Inst. Wien, 20: 159–272.

*References consulted by author—other references are those included in discussion or review sections of the consulted references.

A REVISION OF THE AMERICAN SPECIES OF DICERATOSMIA

(Hymenoptera, Megachilidae)

CHARLES D. MICHENER
University of Kansas, Lawrence

The genus *Diceratosmia* is closely related to the large and well known genus *Osmia*. It has been separated, however, by recent authors (Sandhouse, 1939; Michener, 1941, 1944) largely on the basis of the longitudinal carina along the inner ventral angle of each posterior coxa. There are also certain other generic characters, as detailed by Michener (1941).

Genus **Diceratosmia** Robertson

Diceratosmia Robertson, 1903, Trans. Amer. Ent. Soc., 29: 166.

Type: *Osmia quadridentata* Cresson, =*Osmia conjuncta* Cresson (original designation).

KEY TO THE AMERICAN SPECIES OF DICERATOSMIA

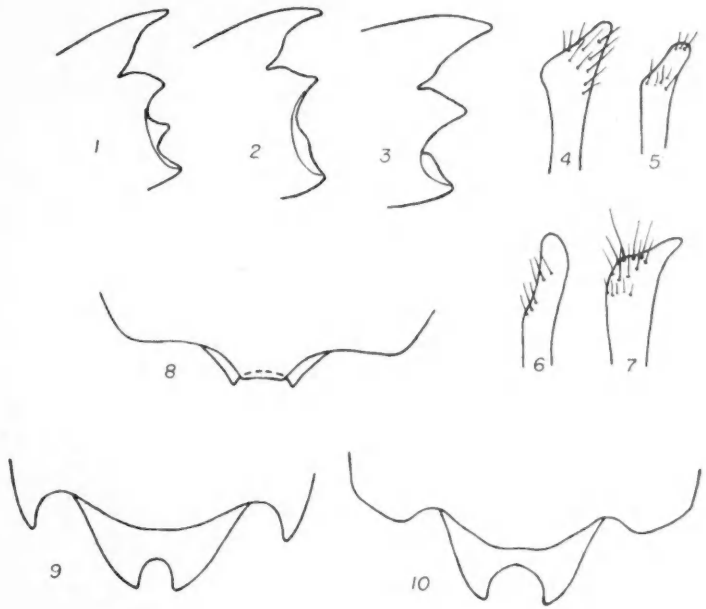
1. Body black; pubescence long, red or reddish; mandibles of female quadridentate (Mexico to Costa Rica) ..... **azteca**
   Body blue; pubescence short, whitish; mandibles of female tridentate, sometimes with weak convexity between second and third teeth (United States and Northern Mexico) 2
2. Males 3
   Females 5
3. Seventh abdominal tergum produced at each side to a large acute tooth similar in shape to the teeth of the eighth tergum 4
   Seventh abdominal tergum at each side with an obtusely rounded projection, much shorter and broader than teeth of eighth tergum ..... **subfasciata**
4. First flagellar segment at least as long as second; antennae and tegulae black, ... **conjuncta**
   First flagellar segment shorter than second; antennae and tegulae partly brown ..... **botitena**
5. Distance between first and second mandibular teeth less than that between second and third ..... **conjuncta**
   Distance between first and second mandibular teeth subequal to that between second and third ..... **subfasciata**

Diceratosmia azteca (Cresson)

Female.—Length 8.5 to 12.5 mm. Black with long reddish pubescence; head and thorax rather finely and closely punctate, propodeal enclosure dull and roughened; clypeus with median truncation, the margin of which is rather broadly impunctate; truncation shorter than distance from its end to lateral angle of clypeus, and projecting somewhat anteriorly so that angles demarking truncation are more conspicuous when viewed from above than from in front; distance between posterior ocelli far less than distance from one of them to posterior margin of vertex or to eye margin; mandible quadridentate (fig. 1), carinae of outer face expanded basally to form large smooth flat area obliquely placed on mandible; genal areas wider than eye seen

from side; dorsum of second abdominal tergum with punctures as coarse as thorax, but other terga much more finely punctate, the punctures rather close except middorsally on third and fourth terga; all terga with erect pubescence which is more abundant along posterior margins.

Male.—Length 8 to 10 mm. Similar to female; clypeal margin approximately as in *D. conjuncta;* mandibles bidentate, with smooth flat area on outer surfaces less extensive than in female; antennae



FIGS. 1 to 3. Apices of mandibles of females: 1, *D. azteca;* 2, *D. conjuncta;* 3, *D. subfasciata.* FIGS 4 to 7. Apices of male gonocoxites (inner margin to right): 4, *D. subfasciata subfasciata;* 5, *D. botitena;* 6, *D. conjuncta;* 7, *D. azteca costaricensis.* FIGS. 8 to 10. Posterior margins of seventh and eighth abdominal terga of male: 8, *D. azteca azteca;* 9, *D. conjuncta;* 10, *D. subfasciata subfasciata.*

reaching well behind tegulae, first flagellar segment conspicuously shorter than second; third abdominal sternum large, broadly rounded, sometimes feebly emarginate medially; fourth broadly emarginate with very long fringe; fifth with margin broadly rounded except for feeble median concavity; seventh tergum with broadly obtuse lateral angles and narrow median (sometimes feebly emarginate) produced truncation (fig. 8); eighth tergum bidentate; coxopodite of genitalia rather broad subapically, abruptly narrowed to inward directed process (fig. 7).

Diceratosmia azteca azteca (Cresson)

Osmia azteca Cresson, 1878, Trans. Amer. Ent. Soc., **7**: 105.
Diceratosmia azteca, Sandhouse, 1939, Mem. Ent. Soc. Washington, 1: 139.
Osmia erythrotricha Cockerell, 1912, Ann. Mag. Nat. Hist., (8)9 561; Cockerell, 1949, Proc. U. S. Nat. Mus. 98: 450.

Usually larger than the following form; genal area of female little more finely punctate than mesepisterna; emargination between teeth of eighth tergum of male semicircular.

The type of *azteca*, in the Academy of Natural Sciences of Philadelphia, is from an unknown locality in Mexico. Specimens have been studied from near Mexico City, Mexico, September 1, 1897 (O. W. Barret). The type of *erythrotricha* was merely labeled "Guatemala." It has not been available for study but the name seems almost certainly synonymous with *azteca*. An additional specimen from Río Pensativa, Guatemala, is recorded by Cockerell.

Diceratosmia azteca costaricensis (Friese)

Osmia costaricensis Friese, 1925, Stettiner Ent. Zeitung, 86(2): 37.

Usually smaller; genal areas of female distinctly more finely punctate than mesepisterna; emargination between teeth of eighth tergum of male broad and shallow.

Specimens have been studied from San Jose, Costa Rica, 1898 and 1923.

Diceratosmia conjuncta (Cresson)

Osmia conjuncta Cresson, 1864, Proc. Ent. Soc. Philadelphia, 3: 31; Robertson, 1897, Trans. Acad. Sci. St. Louis, **7**: 347; Friese, 1911, Das Tierreich, Lf. 28, p. 150; Cresson, 1916, Amer. Ent. Soc., Mem. 1, p. 116; Viereck, 1916, Connecticut Geol. Nat. Hist. Surv. Bull., **22**: 750; Sandhouse, 1925, Canad. Ent., 57: 36, 64; Leonard, 1926, Cornell Univ. Agr. Expt. Sta., Mem. 101: 1030; Robertson, 1928, Flowers and Insects, p. 8; Graenicher, 1935, Ann. Ent. Soc. Amer., 28: 305; Rau, 1937, Ann. Ent. Soc. Amer., 30: 330; Brimley, 1938, Insects North Carolina, p. 458.
Diceratosmia conjuncta, Sandhouse, 1939, Mem. Ent. Soc. Washington 1: 139.
Osmia 4-dentata Cresson, 1878, Trans. Amer. Ent. Soc., **7**: 107.
Osmia quadridentata Dalla Torre, 1896, Cat. Hymen., vol. 10, p. 392; Cresson, 1916, Mem. Amer. Ent. Soc. 1: 120.
Diceratosmia quadridentata Robertson, 1903, Trans. Amer. Ent. Soc., 29: 171.
Osmia cressonii Dalla Torre, 1896, Cat. Hymen., vol. 10, p. 392.

Female.—Length 8 to 9 mm. Dull blue with whitish pubescence; head and thorax rather finely and closely punctate except for mesoscutellum which is conspicuously more coarsely punctate than rest of thorax; propodeal enclosure dull and roughened, especially above. Clypeus with median often somewhat emarginate truncation, its margin black and narrowly impunctate; truncation shorter than distance from its end to lateral angle of clypeus; distance between posterior ocelli slightly less than distance from one of them to eye margin or to posterior margin of vertex; mandible tridentate with slight convexity between second and third teeth (fig. 2); distance between first and second teeth conspicuously less than that between second and third; mandible without flat shining area on outer surface; genal areas about as wide as eyes, seen from side; abdomen more finely punctured basally than most parts of thorax, but fifth and sixth terga about as coarsely punctured as mesoscutum.

Male.—Length 7.5 mm. to 8.5 mm. Similar to female; clypeal margin with short, slightly concave median section demarked by weak angles; mandibles bidentate; antennae brownish black, reaching somewhat behind tegulae; first flagellar segment at least as long as second, flagellar segments except the last less than twice as long as broad; distance between posterior ocelli equal to distance from one of them to eye margin or posterior margin of vertex; third abdominal sternum large and broadly rounded posteriorly, sometimes with feeble median emargination; fourth broadly emarginate with long fringe arising from emargination; fifth broadly rounded; seventh tergum with strongly produced lateral angles (fig. 9); eighth bilobed; coxopodite of male genitalia slender apically (fig. 6).

Distribution.—Connecticut, Ontario, and Wisconsin south to North Carolina and Missouri. ONTARIO: Toronto. NEW YORK: Ithaca. WISCONSIN: Milwaukee. ILLINOIS: Augerville, Carlinville. MISSOURI: St. Louis. MARYLAND: Cabin John, Plummers Island. VIRGINIA: Edsall, Great Falls, Chevy Chase, Falls Church.

Specimens have been collected as early as March 24 (St. Louis) but most collection records are in May. The latest is June 1 (Maryland).

This bee visits a wide variety of flowers, as shown by the following list: *Taraxacum dens-leonis*, *Viola rafinesquii*, *Rubus procumbens*, *Dentaria laciniata*, *Lupinus perennis*.

The types of both *conjuncta* and 4-*dentata* (=*cressonii*) are in the Academy of Natural Sciences of Philadelphia.

Diceratosmia botitena Cockerell

Osmia botitena Cockerell, 1909, Ann. Mag. Nat. Hist., (8)4: 30; Michener, 1936, Bull. Southern California Acad. Sci., 35: 85.
Osmia conjuncta marilaunidii Cockerell, 1914, Ann. Mag. Nat. Hist., (8)14: 363.

Although the above names were placed in synonymy with *D. subfasciata* by Sandhouse (1939), there is little doubt that either a distinct species or a very distinctive Texan subspecies of *D. conjuncta* exists. Certainly the form described as *marilaunidii* is not closely related to *subfasciata*. Unfortunately, the type (a female) of *botitena* cannot now be found (it is not in the United States National Museum nor in the Timberlake collection), and no other females of this form are available. However, this type was before me, in the Cockerell collection, when I wrote (Michener, 1936), "Top of head and thorax green, the punctures smaller (than in *subfasciata*) and about as close as they can be except in center of scutum." From this information, plus certain details from the original description, it is evident that *botitena* is much like *conjuncta*, although the latter is consistently blue. It is not known whether the arrangement of the mandibular teeth is as in *conjuncta*.

The male of *botitena* is thought to be *marilaunidii* although admittedly, in the absence of more information about the female (*botitena*), this is subject to some doubt.

Male.—Length 7 mm. Green or brassy green, bluer laterally. Punctation fully as fine as in *conjuncta;* clypeal margin with small but distinct median emargination marked by small but subacute angles; mandibles bidentate; antennae reaching well behind tegular, flagellum brown, dark above; first flagellar segment distinctly shorter than second,

third to tenth flagellar segments twice as long as broad; distance between posterior ocelli equal to distance from one of them to eye margin or to posterior margin of vertex; third abdominal sternum large and broadly rounded posteriorly, fourth emarginate with long fringe arising from emargination, fifth rounded but more produced posteriorly in the middle than in either *conjuncta* or *subfasciata;* seventh abdominal tergum with strongly produced lateral angles and eighth bilobed; coxopodite of male genitalia slightly broadened subapically.

Distribution.—Texas. This appears to be a rare species. The holotype of *botitena* was from Lee County. The holotype of *marilaunidii* was from Devil's River. Another male specimen is from Kerrville, Texas, on *Nothoscordum*, March 27, 1906 (F. C. Pratt).

Diceratosmia subfasciata (Cresson)

Female.—Length 7.5 to 9 mm. Dull blue or purplish with whitish pubescence; head and thorax rather coarsely punctate with more conspicuous shining interspaces between punctures in many areas, especially the mesoscutum, than in *conjuncta;* mesoscutellum usually scarcely more coarsely punctate than posterior portion of mesoscutum; propodeal enclosure dull and roughened above but shining below. Clypeus with median, often somewhat emarginate, truncation, its margin black and narrowly impunctate; truncation shorter than distance from its end to lateral angle of clypeus; distance between posterior ocelli equal to distance from one of them to eye margin, equal to or slightly less than distance from one of them to posterior margin of vertex; mandible tridentate with very feeble convexity between second and third teeth (fig. 3); distance between first and second teeth slightly greater than distance between second and third; mandible without flat shining area on outer surface; genal areas about as wide as or slightly wider than eyes, seen from side; basal abdominal terga with punctures about as coarse as or finer than those of mesepisterna, punctures coarser apically, coarsest on penultimate tergum.

Male.—Length 6 mm. to nearly 9 mm. Similar to female; clypeal margin with short, slightly concave median section demarked by weak angles; mandibles bidentate; antennae reaching somewhat behind tegulae, first flagellar segment shorter than second, flagellar segments execpt apical one less than twice as long as broad; distance between posterior ocelli equal to distance from one of them to posterior margin of vertex; third abdominal sternum large and broadly rounded posteriorly, fourth broadly emarginate with long fringe arising from emargination; fifth broadly rounded; seventh abdominal tergum with posterior lateral lobes broad and rounded (fig. 10), eighth bidentate; coxopodite of male genitalia broadened subapically, the apical margin oblique (fig. 4).

Diceratosmia subfasciata subfasciata (Cresson)

Osmia subfasciata Cresson, 1872, Trans. Amer. Ent. Soc., 4: 261; Birkman, 1899, Ent. News, 10: 245; Cockerell, 1907, Univ. Colorado Studies, 5: 37; Cockerell, 1911, Proc. U. S. Natl. Mus., 40: 255; Friese, 1911, Das Tierreich, Lf. 28, p. 158; Cockerell, 1914, Canad. Ent., 46: 411; Cresson, 1916, Mem. Amer. Ent. Soc., 1: 131; Michener, 1936, Bull. Southern California Acad. Sci., 35: 85.

Diceratosmia subfasciata, Sandhouse, 1939, Mem. Ent. Soc. Washington 1: 140; Michener, 1947, Amer. Midland Nat., 38: 450.

This is a small subspecies (females usually about 7.5 mm. long, sometimes 8.5; males usually about 6.5 mm.). The punctation is coarse, that of the posterior part of the mesoscutum being as coarse as that of the mesoscutellum. The color is blue. The lateral lobes of the seventh tergum of the male are more evenly rounded than in the subspecies *conjunctiodes*, and the lobes of the eighth tergum are narrowly rounded at their apices.

Distribution.—Northeastern Mexico and Texas to eastern Kansas, eastward to Mississippi and Tennessee; a doubtful record from New Jersey. TAMAULIPAS: Matamoros. TEXAS: Brownsville, Cotulla, Cresson, Dallas, Devil's River, Edna, Falfurrias, Fedor, Gainesville, Harlingen, Kerrville, Ladonia, Llano, Mineral, Neuecest, Paris, Plano, San Antonio, Victoria, Waco, Weatherford, Willis. OKLAHOMA: Hugo, Ardmore. KANSAS: Baldwin. TENNESSEE: Nashville. LOUISIANA: Opelousas. MISSISSIPPI: Hattiesburg. NEW JERSEY: Camden County?

Specimens have been collected as early as March 7 at Brownsville, Texas, but the majority of records are in May, with a few in June, the latest being June 26 at Dallas, Texas.

This bee visits a wide variety of flowers as shown by the following flower records: ***Prunus***, ***Rubus***, ***Cercis canadensis***, ***Achilea***, ***Gaillardia pulchella***, ***Marilaunidium organifolium***, ***Coreopsis cardaminefolia***, ***Helianthus***, ***Monarda citriodora***.

The type, from Texas, is in the Academy of Natural Sciences of Philadelphia.

Diceratosmia subfasciata punctata (Michener)

Osmia punctata Michener, 1936, Bull. Southern California Acad. Sci., 35: 85.
Diceratosmia subfasciata punctata, Linsley and MacSwain, 1947, Jour. Econ. Ent., 40: 354.

This subspecies is very similar to typical ***subfasciata*** but is usually larger (females nearly 9 mm. long) and a little more coarsely punctate and the head in particular is larger, and longer posteriorly, so that unlike most females of typical ***subfasciata***, the distance from a posterior ocellus to the posterior edge of the vertex is distinctly greater than the distance between the posterior ocelli.

Distribution.—The desert regions of Southern California and Arizona. CALIFORNIA: Death Valley, Imperial County, Blythe, Coachella, Oasis. ARIZONA: Yuma.

Specimens have been collected from March to June.

This bee has been collected on flowers of ***Heliotropium*** and ***Prosopis glandulosa***.

The type is at present on deposit in the California Academy of Sciences, San Francisco.

Specimens collected by the author at Edna and 15 miles north of Harlingen, Texas, April 2 and 4, 1946, resemble ***punctata*** and differ from most Texas specimens of this species in their large size. Moreover, a male collected at Oasis, California, by Doctor E. G. Linsley is as small as Texas males, although another male collected at the same time is 7 mm. long.

Diceratosmia subfasciata conjunctoides (Robertson)

Osmia conjunctoides Robertson, 1893, Trans. Amer. Ent. Soc., 20: 276; Friese, 1911, Das Tierreich, Lf. 28, p. 151.
Osmia subfasciata Graenicher, 1930, Ann. Ent. Soc. Amer., 23: 163.

Specimens from southern Florida are so different from typical *subfasciata* that they were at first thought to represent a distinct species. However, through the courtesy of Doctor H. H. Ross, a paratype of *Osmia conjunctoides* Robertson has been available for study. This form was described from Citrus County, in the northern part of peninsular Florida. It is clearly an intergrade between typical *subfasciata* and the form of southern Florida. It has the coloration of the latter form, while the size and the shape of the seventh and eighth abdominal terga of the male are intermediate. It is unfortunate that the type locality of *conjunctoides* is not in southern Florida, where the special characteristics of the Florida population are accentuated. However, the name *conjunctoides* does seem applicable to the population of the whole of peninsular Florida. The following description is based upon material from southern Florida:

This subspecies differs from typical *subfasciata* in its larger size (length of both sexes 8.5 to 9 mm.), darker blue or purplish coloration, and finer and denser punctation. The punctures of the mesoscutum are considerably finer, even posteriorly, than those of the mesoscutellum. Thus the punctation is similar to than of *conjuncta*. The lateral lobes of the seventh tergum of the male are slightly angulate laterally, unlike *subfasciata*, and the lobes of the eighth tergum are longer and more angulate at the apices than in *subfasciata*.

Distribution.—Peninsular Florida (northern specimens seem to intergrade with *subfasciata*). FLORIDA: Citrus County, Charlotte Harbor, Miami, Biscayne Key.

One Miami specimen is labeled January. Graenicher records dates of capture from February 8 to March 17.

The type, from Citrus County, Florida, is in the collection of the Illinois Natural History Survey, Urbana, Illinois.

LITERATURE CITED

Sandhouse, Grace Adelbert. 1939. The North American Bees of the Genus Osmia (Hymenoptera: Apoidea). Mem. Ent. Soc. Washington 1: ii+167 pp., 11 pls.

Michener, Charles D. 1936. New Californian Osmiinae (Hymenoptera, Megachilidae). Bull. Southern California Acad. Sci., 35: 84–93.

1941. A Generic Revision of the American Osmiinae with Descriptive Notes on Old World Genera (Hymenoptera, Megachilidae). Amer. Midland Nat., 26: 147–157.

1944. Comparative External Morphology, Phylogeny, and a Classification of the Bees (Hymenoptera). Bull. Amer. Mus. Nat. Hist., 82: 157–326.

A POPULATION STUDY OF THE ANT APHAENOGASTER FULVA SSP. AQUIA BUCKLEY

(Hymenoptera, Formicidae)

A. E. HEADLEY
Ashtabula, Ohio

This is one of a series of ant population studies and it correlates with a previous paper on populations of two species of *Leptothorax* (Headley, 1943), in which other ant population works were cited, and with a more recent study of *Myrmica schencki* ssp. *emeryana* Forel (Talbot, 1945). The paper deals with *Aphaenogaster fulva* ssp. *aquia* Buckley, a myrmicine ant which is rather widely distributed in the northeastern United States.

For a population study of an ant it is desirable to find numerous colonies living together in one habitat, where it is supposed that conditions of soil, plant cover, temperature, light, humidity and food all blend to make the area a good one for that species. Furthermore, colonies need to be studied throughout the summer to trace the maturing of brood. If all the colonies come from one habitat, other variables, beside the desirable one of time, are held at a minimum. Such an *Aphaenogaster fulva aquia* community was found in Seneca County of north central Ohio.

Description of habitat.—The *Aphaenogaster* plot was a grove of young locust trees one tenth of an acre in size. Under the canopy of trees was a luxuriant, head-high growth of weedy plants: giant ragweed, tall blue lettuce, elderberry, blackberry, burdock, goldenrod and fleabane. Smaller groundcover plants were scarce except at the edges of the grove.

The floor of the locust woods was characteristic, for here there was no heavy matting of leaves such as occur in a beech-maple or an oak forest, but rather an accumulation of leaves and stems. The small locust leaflets dried out readily and curled into crisp brown fragments. They became tangled with the dead locust twigs, elderberry and blackberry branches and stems of nettle, tall blue lettuce and ragweed, making a loose trashy layer upon the soil. The ground itself was a very loose black loam for 3 to 4 inches, solid brown soil for another 10 to 12 inches and below that hard yellow clay. There were no stones or rocks, but roots interlaced in all directions.

All of these conditions taken together seemed to make a good habitat for *Aphaenogaster fulva aquia* because colonies were found in abundance. The soil held moisture well and the dense covering of tall weeds affected the humidity of the ground as well as its surface which remained moist except in extremely dry weather. But it was the litter on the surface of the ground that seemed especially favorable for *Aphaenogaster*. The ants used the leaves, twigs and hollow stems in various ways for nest cover and above-ground chambers for speeding the development of young ants.

The locust woods was not only a favorable location for *Aphaenogaster fulva aquia* but it also harbored a number of other ant species. *Stenamma brevicorne* Mayr was abundant just under the surface of the soil and *Brachymyrmex heeri depilis* Emery was occasionally encountered. *Ponera coarctata pennsylvanica* Buckley, a subterranean ant, was common, and *Stigmatomma pallipes* Haldeman was found in the upper two inches of soil. *Prenolepis imparis* Say nests were frequently cut into while digging for *Aphaenogaster*, and other ants, such as *Tapinoma sessile* Say, *Myrmica schencki emeryana* Forel, *Leptothorax curvispinosus* Mayr, *Solenopsis molesta* Say and *Lasius niger alienus americanus* Emery, patrolled the surface. The woods was also invaded by ants which nested near its rim. These were *Aphaenogaster tennesseensis* Mayr, *Camponotus caryae* Fitch, *Camponotus herculeanus pennsylvanicus* De Geer, *Formica fusca subsericea* Say and *Formica pallidefulva schaufussi incerta* Emery. Thus there was in the woods a cosmopolitan mixture of sixteen kinds of ants, each colony a community in itself, yet living together in a restricted habitat with seemingly ample food and nesting space.

Nest structure.—In other localities *Aphaenogaster fulva aquia* nests are often under stones, in much-decayed logs, under layers of leaves, or more seldom in open ground. But at the locust grove they were almost always covered with a trashy litter. Twigs, small bits of plant stems and curled up locust leaves covered the nests. Ants were traced home by giving them bits of cake crumbs, and usually they simply disappeared among the leaves. Then the covering had to be picked away and a hunt made for the nest entrance in the soil. Picking away the litter had to be done carefully for often there were larvae and pupae piled among the leaves, thus making them serve as above-ground brood chambers. Entrances were sometimes hard to find, for the ants occasionally had passageways under the leaves for several inches. Usually the soil about the entrance was loose and it might be raised a little from the surrounding surface. In this loose soil entrances were sometimes nicely rounded and definite holes one-eighth to one-fourth inch in diameter, sometimes natural-looking cracks. Most nests had more than one entrance; the average was 2.3 and the extreme found was 8. Usually the multiple entrances were within three or four inches of each other, but they were sometimes as much as eight inches apart.

After entrances were located, they were filled with white ink which ran down and so marked the galleries. Then a half-moon shaped hole was dug to the side of the nest area so that the nest could be uncovered layer by layer. Usually the ground was black, loose, and crumbly and mixed with debris for the first few inches. This made near-the-surface chambers hard to determine because digging tended to cave them in. When multiple openings occurred, there were one or two horizontal galleries connecting them and from one to seven chambers within the first two inches of soil (Figures 1 and 2). Below two or three inches, galleries tended to converge and extended vertically down into the more solid soil. Usually there was only one such gallery but cases of two, three or even four were found. Along the gallery, chambers extended out and housed workers, pupae, larvae and eggs. The nests

dug averaged 6.5 chambers with extremes ranging from 2 to 17. Chambers had rounded ceilings and flat floors and were rather uniformly one-half inch high. They were three-fourths to two inches long and about one-half inch wide. Nests varied greatly as to depth from no depth at all, in colonies which were living entirely above ground, to 34 inches, with a mean depth of 9.03 inches. Depths were recorded for separate months to see if seasonal variation could be detected.

Month	*Number of Nests*	*Mean Depth*	*Range*
June	14	5.18	0–20
July	11	5.83	0–20
August	15	14.93	8–34

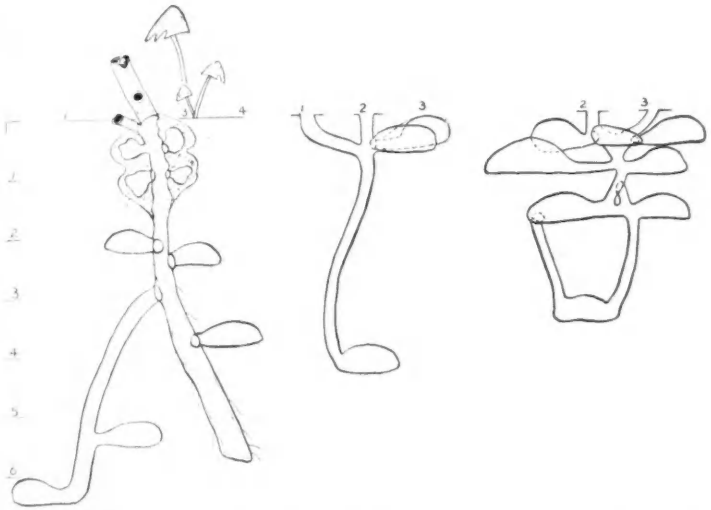


FIG. 1. Three types of small nests of the ant *Aphaenogaster fulva aquia*. A. Nest using small bit of stem and root of plant; dug July 20, 1946. B. Small simple nest; dug June 12, 1946. C. Typical shallow nest with chambers near surface; dug June 11, 1946.

The greater depth of nests in August may have been due to drier conditions, for it has been noticed that *Aphaenogaster* tend to bring their brood to the surface during wet weather and to go deeper during dry. No correlation between size of nest and size of colony could be detected.

Variation in nests.—*Aphaenogaster fulva aquia* showed versatility in using a variety of materials to supplement or even replace the nests excavated in the soil. Some examples follow. Two colonies were nesting in the trunks of dead, standing locust trees. There was no connection of the nest with the soil, entrances were a little above the

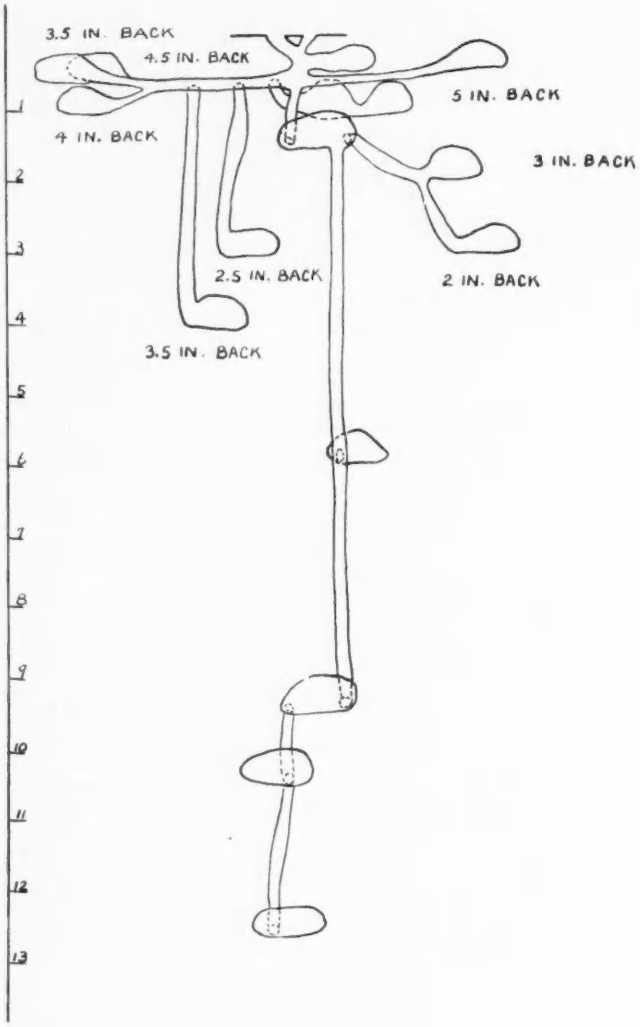


FIG. 2. A large nest of *Aphaenogaster fulva aquia*.

ground and chambers were constructed in the decaying wood. One complete colony was found in the upright living stem of tall blue lettuce (*Lactuca spicata*). (This plant was common in the locust woods, grew from five to seven feet tall and had a hollow stem one-half to three-fourths of an inch in diameter). The nest opening was a round hole a foot from the ground and above this was a series of semicircular platforms which seemed to have been constructed by the ants and upon which the brood rested. Three colonies were found nesting in hollow dead stems as they lay upon the ground. The broken ends were plugged

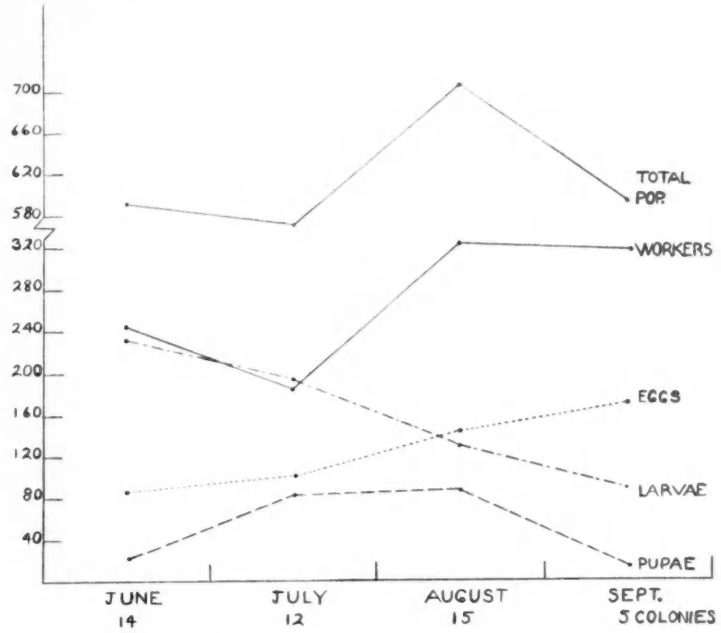


FIG. 3. Means of developmental stages of *Aphaenogaster fulva aquia* during the summer months.

with pellets of debris and entrances were made in the sides. Food was brought in through the entrances and the entire colony, including the queen, lived in the stem.

Other colonies combined these hollow stems with regulation underground nests by using them as above-ground chambers into which pupae and large larvae were brought for speeding up development in a warm dry place. A variety of hollow stems such as nettle, ragweed, elderberry and tall blue lettuce was available for this function. Sometimes the stems were just above the nest entrances but sometimes the ants carried brood for three or four inches to a suitable stem. More fragile above-

ground chambers were made of curled-up leaves. Sometimes brood was simply piled between leaves and layers of small twigs which lay above the nest entrance. These above-ground chambers, of whatever nature, seemed to be quite temporary and ants were constantly bringing brood to them or carrying it away. Colonies living in stems must have to move frequently because stems are often crushed or displaced, or stems may be summer homes for colonies which will move underground before winter. The tendency to live above ground seemed most conspicuous during wet periods when the ground was soaked.

One colony utilized a root, as well as a bit of stem, for its nest (Figure 1). In this instance a very short piece of stem was attached to a root which was bulbous at the ground surface and then extended down for five inches as a narrow gallery-size tube. The ants used the short stem as an above-ground chamber and filled it with pupae. They had hollowed out the bulbous portion of the root into four chambers and used the rest of the root as a gallery. Extending out from it were three chambers excavated in the soil and a secondary gallery from which radiated two more chambers.

The ants were apt to use natural crevices in the soil instead of doing their own digging. Since earthworm holes were very common, the ants frequently adopted one and used it as a gallery around which they constructed chambers. These wormhole galleries could be recognized because they were larger in diameter and smoother than galleries which the ants dug for themselves.

Populations.—Colonies in the locust woods were numerous but not large (Table I). (Farther north, along the shore of Lake Erie, I have found habitats where *Aphaenogaster* were abundant under stones and where colonies seemed consistently two or three times as large). The mean population for the 46 colonies was 656.66. These averaged 280.47 workers, 63.28 pupae, 182.43 larvae and 120.83 eggs. No first-year colony was found; the smallest consisted of 58 individuals of which 20 were workers. The largest colony found was made up of 1440 individuals of which 950 were workers. This colony was one of two found which had two queens.

Since similar studies were made of two species of *Leptothorax* (Headley, 1943) it may be interesting to compare populations of these three myrmicine ants.

	Number of Colonies	*Mean Population*	*Range*	*Mean of Workers*
A. fulva aquia	46	656 66	58–1440	280 47
L. curvispinosis	38	235 00	31–727	82 6
L. longispinosis	97	135 90	7–419	45 8

The make-up of an ant colony varies during the season with the maturing of brood (Figure 3). A nest dug November 20, 1947, revealed that this species overwinters, not only as larvae, but also as eggs. The count for that colony was 880 workers, 519 larvae and 647 eggs. The overwintered larvae become the year's first callow workers and also seem responsible for all of the males and females produced. When digging began, during the first week of June, there were as yet no pupae but they were present by June 10 and remained as a part of the population from then on, reaching their height in July and August. Egg

TABLE I

POPULATION DATA, COLONIES OF *Aphaenogaster fulva aquia*, LOCUST WOODS

Date	Winged Queen	Worker Workers	Male Males	Female Females	Pupae	Pupae	Pupae	Larvae	Eggs	Total
6– 6–47	1	130							25	156
6– 6–47	1	31						21	51	104
6–10–46	1	490						316[1]	255	1062
6–10–47	1	410			16			139	40	606
6–11–46	1	117			31			174	108	431
6–11–46	0	131						91[2]	23	245
6–12–46	1	48			1			99	64	213
6–12–46	1	418			34			387	112	952
6–16–47	0	298			17			140	22	477
6–18–45	1	456						351	55	873
6–21–47	1	296			38			426	124	884
6–21–47	1	185			70			394	107	757
6–24–46	1	167			69			410	107	754
6–26–47	1	246			44	15	1	336	157	800
7– 1–47	1	43			30			80	79	233
7– 1–47	1	11			12			72	42	138
7– 1–47	0	138			6	6		67	77	294
7– 3–47	1	224			59	32		418	137	871
7– 3–47	0	119			35	6		122	28	310
7– 3–47	1	20			3			18	16	58
7–19–46	1	174			28			48	173	324
7–19–46	1	255			172			211	235	874
7–20–46	1	285	15		91	24		275	119	810
7–22–46	1	356			275			449	56	1137
7–23–46	1	219			66			306	99	691
7–31–46	1	384	11	2	219			248	150	1015
8– 5–47	1	204			224			303	132	864
8– 7–46	1[3]	193	52	16	23			7	0	292
8–14–46	1	258			93			118	268	738
8–21–46	1	154			36			84	193	468
8–23–47	1	146			41			61	81	330
8–23–47	1	652			145			232	191	1221
8–25–47	1	275			51			80	92	499
8–26–46	0	328	3		58			39	41	469
8–27–47	1	242			62			73	82	460
8–27–47	1	299			88			174	336	898
8–27–46	2	38			0			10	12	62
8–27–46	1	509			121			76	163	1070
8–29–45	1	720	17		242			169	231	1380
8–30–45	1	538			151			84	324	1098
8–31–45	1	277			8			453	39	778
9– 2–44	0	357			2			52	149	560
9– 4–44	2	950			9			161	322	1440
9– 8–47	1	74			12			119	91	297
9– 8–47	1	30			18			17	44	110
9– 8–47	1	180			30			110	248	569

[1]Eight were female larvae.
[2]Fourteen were female larvae.
[3]Dead but still lying in the nest.

laying continued uninterrupted throughout the summer. Larvae were at their peak in June as a result of an accumulation of overwintered larvae plus those from overwintered and spring laid eggs. Workers did not reach their full strength until August when these larvae had had time to pupate and emerge. Young workers developed pigment rapidly and there were never many callows in the nest. Figure 3 shows the relative abundance of the developmental stages during the summer.

Since workers must forage for and feed the larvae, as well as themselves, it was thought of interest to compare the relative abundance of these two stages. In June there were 1.09, in July only 0.96, and in August 2.46 workers for every larva. Through the summer the colonies showed slightly more brood (eggs, larvae, pupae) than workers. In June there were 1.40 brood per worker, in July 2.03, and in August 1.14. If many more young than adults means rapid growth in a population then it would seem that *Aphaenogaster fulva aquia* colonies increase in size rather slowly.

Also the number of colonies does not increase rapidly, if meagerness of winged forms can be taken as an indication. In spite of the fact that, during three seasons, 36 colonies were dug within the time when males and females might have been expected, only 11 colonies possessed them. Development of the winged ants spread over the summer. Male larvae could not be distinguished but female larvae were recognizable by June 10 because of their large size. The first male and female pupae were found on June 26 and adult winged ants did not emerge until the latter part of July. No flights were seen but it is assumed that they occur in August.

SUMMARY

Forty-six colonies of the ant *Aphaenogaster fulva aquia* were studied during June, July and August in a small locust woods in Seneca County, Ohio. Nest structure showed great variation and versatility in using various materials. Most nests were excavated in the soil and consisted of one to four galleries extending 1 to 34 inches deep, from which radiated 2 to 17 chambers, but some colonies nested above ground under bark of standing trees, in hollow stems or simply among the leaves and twigs which covered the ground. Many nests had one or two above-ground chambers combined with the below-ground ones. The ants often utilized hollow roots, earthworm holes and natural crevices.

Populations were not large, ranging from 58 to 1440 individuals with a mean population of 656.66. Eggs and larvae were overwintered and pupation began early in June, but workers did not reach full strength until August. Males and females apparently developed from the overwintered larvae and emerged as adults during the latter part of July.

LITERATURE CITED

Headley, A. E. 1943. Population studies of two species of ants, *Leptothorax longispinosus* Roger and *Leptothorax curvispinosis* Mayr. Ann. Ent. Soc. Amer., 36: 743–753.

Talbot, Mary. 1945. Population studies of the ant *Myrmica schencki* ssp. *emeryana* Forel. Ann. Ent. Soc. Amer., 38: 365–372.

THE GENERIC IDENTIFICATION OF NEARCTIC REDUVIID NYMPHS

(Hemiptera)[1]

S. B. FRACKER

Agricultural Research Administration,
U. S. Department of Agriculture,

AND

R. L. USINGER

University of California,
Berkeley

The senior author in December, 1933, began the accumulation of a series of notes as to the structure of the nymphs of Reduviidae with the hope of arranging a synopsis which would aid in the identification of unknown immature members of this family. The material consisted of the collections of the United States National Museum.

Many of the genera of Reduviidae occurring in the United States are represented by nymphs in this collection, although the reliability of the identification varies considerably. Very few of the specimens have been reared from the eggs laid by known females, the only way of securing positive identification. Some of the nymphs have been so characteristic that they have been determined by their resemblance to adults, while others have apparently been determined on the basis of the adult Reduviidae which were found in the immediate vicinity, perhaps on the same day.

The completed manuscript which resulted from the above-mentioned work was referred to the junior author in 1947. The junior author checked the basic keys against material in his own collection and in the collection of the California Academy of Sciences. Many additions and corrections were made as a result of this study. This paper is thus a joint effort based upon examination of the nymphs of four-fifths of the genera of Reduviidae known to occur in the United States.

The need for a special key for the identification of nymphs and apterous adults is due to the fact that the characters used for the separation of the winged adults into subfamilies and groups of genera (Fracker, 1912) are not always available in the wingless forms. These characteristics include the presence, absence, or relative position of the ocelli, the nature of the venation of the hemelytra, the transverse division of the pronotum (the pronotum of the nymphs not being so divided), and the presence or absence of a tubercle on the side of the mesothorax adjoining the pronotum. The absence of these characters in the nymphs makes it impossible to trace them through any published keys.

[1]The authors wish to acknowledge with thanks the interest and suggestions of Dr. Paul W. Oman and Dr. R. I. Sailer, who have reviewed the manuscript.

After a series of notes had been accumulated, it became clear that, to a large extent, the same subfamily groups could be delimited on the basis of characters present in the nymphs and not heretofore recorded or used by hemipterists, and that these new characters proved in most cases to be constant through all the available material from the first stage nymphs to the adults themselves. Unfortunately, a number of the genera are not represented by nymphs in our collections and a synopsis based solely on the available material would accordingly show certain gaps. In tracing a specimen through such a key and finding that it complied with the description of a certain genus, one would feel uncertainty as to whether it might not belong to one of the other genera in the same group. After considerable thought and study it was decided that the needs of entomologists would best be served by including such closely related genera and showing those characters which were present in the adults and which observation had indicated might be constant throughout the entire life cycle of the insect.

The synopsis presented later in this paper, therefore, consists of an arrangement of the genera of Reduviidae, under which it is hoped that any specimens of nymphs or adults of the United States may be placed in their proper genera. Those genera in which nymphs have been studied are indicated by an asterisk.

It should be understood that the characters used apply in many cases only to genera and species found in North America. One of the best examples of the significance of that fact is the subfamily Apiomerinae which was erected by Stål to include a group of genera which have their ocelli farther apart than the eyes. No nymphs of this subfamily were available except those belonging to the genus *Apiomerus*, the only genus occurring in North America. The subfamily character given in this paper accordingly uses the peculiar shapes of the tarsi and tibiae which characterize the latter genus but not the more tropical genera of the subfamily.

The writers have been interested in some of the theoretical implications of the observations here reported. It was thought that the nymphs in developing through their successive instars would probably show changes by means of which new light would be thrown on the relationships of the different genera and subfamilies. The writers were somewhat surprised to discover, therefore, the constancy with which these new characters, particularly the relative lengths of the segments of the antennae and beak, the shape of the coxae, and the number and position of the dorsal abdominal scent glands, (Readio, 1927, and Usinger, 1943), were retained throughout the nymphal period of development. At the present stage of observation, we are unable to add any new contributions to the relationship of the members of this family to each other. The only grouping which broke down completely and which was not confirmed by any character of the nymphs yet discovered, was the division of the subfamily Harpactorinae into two tribes on the basis of the presence or absence of the mesothoracic tubercle mentioned above.

A synopsis of the subfamilies and genera of the nymphs and adults of the Reduviidae of the United States prepared on the plan above outlined follows.

KEY TO THE GENERA OF REDUVIIDAE OF THE UNITED STATES

1 (18) Anterior coxae elongated, usually at least four times as long as wide and usually extending well beyond apex of head..... **EMESINAE**

2 (15) Fore tarsi distinctly segmented, sometimes heavily sclerotized and the segments subfused, but the dividing sutures always visible under a high-power lens; claws of fore tarsus consisting of an equal-sized pair (except in some species of *Ploiaria*).

3 (4) Fore femora without distinguishable ventral spines or bristles, only fine hairs; third antennal segment as long as second and about three times as long as fourth..... **Emesopis**

4 (3) Fore femora with distinct spines or bristles on ventral surface which are readily distinguishable from any fine hairs which may be present (except in some species of *Empicoris*); third antennal segment not nearly so long as second and frequently shorter than fourth.

5 (12) Ventral spines on fore femur commencing at or very close to base; fore tibia very distinctly over half as long as fore femur.

6 (7) Prothorax with a deep constriction, distinctly bilobate, pedunculate, the nymphs without posterior enlargement over mesonotum but still pedunculate, strongly widened anteriorly..... **Stenolemus**[2]

7 (6) Prothorax not as above, never more than slightly constricted.

8 (9) Fore tarsus long, about half as long as tibia, heavily sclerotized and bare above, the segments fused so closely that the oblique sutures are visible only under a very high power lens..... **Ploiaria***

9 (8) Fore tarsus very short, much less than half as long as tibia, not heavily sclerotized and not bare above, the segmentation distinct.

10 (11) First segment of rostrum long, reaching to eyes, longer than second or third segment and over half as long as second and third segments together; adults with two-segmented fore tarsi..... **Empicoris***

11 (10) First segment of rostrum shorter, not reaching to level of eyes, much shorter than second or third segment and less than one-fourth as long as second and third together; adults with fore tarsi three-segmented, **Lutevopsis**

12 (5) Ventral spines on fore femur commencing at or near the middle; fore tibia not or but little over half as long as fore femur.

13 (14) Fore tibia about half as long as fore femur; basal ventral spine of fore femur not longer than the longest of the others; fore tarsus with the segments well defined, not heavily sclerotized, hairy above... **Gardena***

14 (13) Fore tibia not nearly half as long as fore femur; basal ventral spine of fore femur very distinctly longer than the longest of the others; fore tarsus with the segments poorly defined, heavily sclerotized, bare above..... **Emesaya***

15 (2) Fore tarsi without distinguishable segmentation under the highest power lens, consisting of but one heavily sclerotized segment with an unequal pair of claws, a single claw, or without distinct claws.

16 (17) Fore tarsus with two longitudinal series of angularly deflected spines; labrum closely adherent to base of rostrum, not projecting spine-like, **Ghilianella***

17 (16) Fore tarsus with two series of setulose hairs on its ventral surface; labrum projecting spine-like above base of rostrum..... **Metapterus***

18 (1) Anterior coxae shorter, not more than twice as long as broad and not extending beyond apex of head.

19 (22) Second segment of beak angularly dilated at middle and armed above with a pair or tuft of stiff setae; second antennal segment much shorter than first; no ocelli in either adults or nymphs..... **SAICINAE**

20 (21) Pronotum armed with spines; prothorax with porrect prolongation on each side below..... **Saica***

21 (20) Pronotum unarmed (at least in adult); prothorax without porrect prolongations below..... **Oncerotrachelus**

[2] *Stenolemoides* M. & M. has been raised from subgenus to genus (Wygodzinsky, 1946). Adults differ from **Stenolemus** in that the posterior lobes of head and pronotum lack tubercles.

22 (19) Second segment of beak cylindrical or slightly spindle-shaped, not angularly dilated and armed above.
23 (58) Second segment of antennae about one-fourth longer than first; latter often thickened and shorter than anteocular part of head.
24 (29) Anterior coxae about twice as long as wide, subcylindrical except for flattened lateral surface, nearly half as long as femora; second antennal segment about twice length of first; first segment of beak shorter than second ..... **PIRATINAE**
25 (26) Middle tibia without spongy fossa; head long, porrect; no lateral tubercles on neck ..... **Sirthenia***
26 (25) Middle tibia with spongy fossa; head short, deflexed.
27 (28) Anterior tibia abruptly dilated in apical half, inner apical margin of femur opposite slender basal half of tibia with numerous short, stiff spines in addition to long bristles ..... **Melanolestes***
28 (27) Anterior tibia not abruptly dilated at middle, inner apical margin of front femur without short, stiff spines ..... **Rasahus***
29 (24) Anterior coxae about as long as wide, globose or conical, scarcely one-fourth as long as femora.
30 (33) Antennae with second segment composed of numerous subsegments; nymphs with basal segment of posterior tarsi usually half as long as apical ..... **MICROTOMINAE**
31 (32) Body hairy, hairs of legs as long as femora are thick; head short, not produced in front of antenniferous tubercles ..... **Homalocoris***
32 (31) Body not noticeably hairy, hairs shorter; head long, produced in front of antenniferous tubercles ..... **Microtomus***
33 (30) Antennae with second segment not composed of subsegments; nymphs with basal segment of posterior tarsi usually about one-fourth as long as apical.
34 (35) No spiracular orifices visible on mesothorax of nymphs; scutellum when visible with apex bifurcate or trifurcate; abdominal scent gland openings at base of fifth and sixth segments,[3] **ECTRICHODIINAE, Rhiginia***
35 (34) Spiracular orifices visible and well developed on mesothorax of nymphs; adults with apex of scutellum rounded or pointed; abdominal scent gland openings not as above.
36 (43) Abdominal scent gland openings on fourth, fifth, and sixth segments, or absent; second segment of beak usually longer than first.
37 (40) Head strongly produced cephalad, not deflexed at tip; antennae inserted on sides; beak straight, close to ventral side of head throughout length; abdominal scent gland openings absent ..... **TRIATOMINAE**
38 (39) Body naked or with short pubescence, the individual hairs shorter than spaces between hairs; pubescence of appendages shorter than thickness of appendages ..... **Triatoma***
39 (38) Body clothes with long pubescence, the individual hairs longer than spaces between hairs; pubescence of appendages longer than thickness of appendages ..... **Paratriatoma***
40 (37) Head deflexed, beak curved, usually not close to ventral side of head throughout length; abdominal scent gland openings sometimes small but present on fourth, fifth, and sixth segments ..... **REDUVIINAE**
41 (42) Body nearly naked (adults) ..... **Pseudozelurus**[4]
42 (41) Body densely hairy ..... **Reduvius***
43 (36) Abdominal scent gland openings on fourth and fifth segments; second segment of beak usually shorter than or subequal to first, **STENOPODINAE**
44 (49) Head armed with a furcate spine below on each side behind the eyes.

---

[3]In counting abdominal segments in adults, the first segment which is reduced to a small dorsal plate should not be overlooked. Dorsal abdominal scent gland openings are conspicuous and functional in nymphs. They are inconspicuous but still present in adults.

[4]*Zeluroides* Wygodzinsky (1948) is recorded doubtfully from the United States (Arizona ?). Adults differ from *Reduvius* and *Pseudozelurus* in that the fore and middle femora are spined and the body surface is granular.

45 (46) First segment of antenna incrassate, apex produced in a spine beyond insertion of second segment. . . . . **Pnirontis***

46 (45) First segment of antenna not produced beyond the insertion of second segment.

47 (48) Apex of head at base of rostrum unarmed; first segment of rostrum extending caudad of eyes, nearly twice as long as the two apical segments together; fore femora unarmed. . . . . **Pygolampis***

48 (47) Apex of head produced into a short, porrect obtuse spine on each side at base of rostrum; first segment of rostrum extending to caudal margin of eyes, subequal in length to the two apical segments together; fore femora with a double series of short spines below. . . . . **Gnathobleda***

49 (44) Head unarmed below or armed with a simple spine, rarely a subfurcate spine at base.

50 (53) Anteocular part of head two or three times as long as postocular, nearly twice as long as wide; fore femora armed with a row of short spines or tubercles beneath.

51 (52) First segment of beak one-third longer than second; head subcylindrical, the sides of anterior lobe subparallel. . . . . **Stenopoda***

52 (51) First and second segments of beak subequal; head relatively broad, the sides of anterior lobe rounded. . . . . **Oncocephalus***

53 (50) Anteocular part of head about as wide as long, not over twice as long as postocular part.

54 (55) Fore femora swollen, armed with short spines beneath, longest near base, **Ctenotrachelus***

55 (54) Fore femora not swollen, unarmed.

56 (57) Head not produced in front of antenniferous tubercles, anteocular part a little longer than postocular. . . . . **Diaditus**

57 (56) Head produced in front of antenniferous tubercles, anteocular part twice as long as postocular. . . . . **Narvesus**

58 (23) Second segment of antennae subequal to or much shorter than first.

59 (60) Anterior tarsi minute, retractile within a groove of the greatly swollen tip of the anterior tibiae; first and second antennal segments subequal, with minute spherical subsegment between successive principal segments; beak with second segment several times as long as first, **APIOMERINAE Apiomerus***

60 (59) Anterior tarsi not minute and retractile within tip of tibiae, latter never greatly swollen at tip; first antennal segment much longer than second, over twice as long except in *Rhynocoris*. . . . . **HARPACTORINAE**

61 (64) Second segment of beak at least 1.5 as long as first, usually nearly double the length of the first.

62 (63) First segment of antennae nearly twice as long as head. Anterior femora longer than posterior. . . . . **Zelus***

63 (62) First segment of antennae about as long as head. Anterior femora shorter than posterior or subequal. . . . . **Rhynocoris***

64 (61) Second segment of beak subequal to or shorter than first.

65 (80) Anterior femora not armed with spines.

66 (69) Head behind bases of antennae with blunt elevations but without distinct dorsal spines.

67 (68) Pronotum with antero-lateral angles armed with a subacute process; legs annulate, black and yellow. . . . . **Pselliopus***

68 (67) Pronotum with antero-lateral angles rounded; legs not with numerous annulae, occasionally with one or two rings. . . . . **Castolus**

69 (66) Head bearing a distinct dorsal spine behind each antenna.

70 (71) Lateral angles of next to the last abdominal segment each armed with a spine. . . . . **Atrachelus**

71 (70) Lateral angles of abdominal segments not armed or with small spines on anterior segments only.

72 (77) Pronotum armed with four dorsal spines on the disk.

73 (76) Head as seen from the side gradually narrowed into a neck.

74 (75) (Adults with a tubercle or fold on the mesosternum in front, tubercle scarcely distinguishable in nymphs). . . . . **Heza***

75 (74) (Adults without tubercle or fold on the mesosternum in front)..**Rocconota**[5]
76 (73) Head as seen from the side suddenly constricted into a neck.....**Repipta***
77 (72) Pronotum sometimes with spines or tubercles at lateral angles but none on the disk.
78 (79) Postocular part of head about half longer than anteocular, gradually narrowed to base from both dorsal and lateral views.....**Arilus***
79 (78) Postocular and anteocular parts of head subequal; former with sides almost parallel to base, lateral view showing pronounced dorsal constriction in basal fourth.....**Fitchia***
80 (65) Anterior femora armed with spines at least at the apex.
81 (84) Femora each with a pair of spines at the extreme apex.
82 (83) Head as seen from the side gradually narrowed to base.....**Ricolla***
83 (82) Head as seen from the side suddenly constricted at base.....**Doldina***
84 (81) Femora not with a pair of spines at the apex.
85 (86) Anterior tibiae armed with long spines.....**Sinea***
86 (85) Anterior tibiae unarmed.....**Acholla***

REFERENCES

Fracker, S. B. 1912. A systematic outline of the Reduviidae of North America. Proc. Iowa Acad. Sci., 19: 217–252. (Year of publication, 1913).
Readio, P. A. 1927. Biology of the Reduviidae of America north of Mexico. Kansas Univ. Sci. Bull. 17: 1–291, 21 plates.
Usinger, R. L. 1943. A revised classification of the Reduvioidea with a new subfamily from South America. Ann. Ent. Soc. Amer., 36: 602–618. 3 figs. (Year of publication, 1944.)

[5]A nymph believed to be *Rocconota annulicornis* traces to *Arilus* in the synopsis; it is distinguishable by the beak, since in *Rocconota* the first and second segments are equal, while in *Arilus* the second is at least one fourth shorter than the first.

THE WAYS OF A MUD DAUBER, by GEORGE D. SHAFER. xiii+78 pages, 10 plates, 9 text figures. Stanford University Press. 1949. Price, $2.50.

The J. H. Fabre style of writing is unfortunately too uncommon in this age of experimental science, in which rigid competition for space and the need for exactness of expression too often lead to an uninteresting, stereotyped style. A few, like W. M. Wheeler, the Peckhams, the late Phil Rau, and Australia's Tarleton Rayment have succeeded in preserving individual readable styles in which to transmit their scientific contributions. These contributions, however, like Fabre's, were mainly in the field of descriptive science. When, on the other hand, an experimental worker, a physiologist retiring from college teaching, turns to observations of the behavior of wasps, but carries over into his descriptive tasks something of the work habits of his previous research, the results are especially interesting.

Dr. Shafer has produced a very readable book that may be enjoyed by the professional entomologist and the non-professional alike. Some parts of it have definitely the Fabre touch; for example, the description of the antics of the "mud dauber of the window," who became such a pet that she bothered the scientist by begging for attention at most inopportune times, or the account of Crumple-Wing, the crippled wasp which he was able to study at close range in her bell-jar home in the laboratory. On the other hand, the discovery of the way in which the uric acid accumulation of the larva is eliminated, though told in the same interesting way, shows the physiologist at work.

The book is based on five years' observations. The original contributions contained in it should not be overlooked by the student of insect behavior or by the arthropod physiologist.—M. T. J.

THE NORTH AMERICAN SPECIES OF PARAGNETINA

(Plecoptera, Perlidae)[1]

WILLIAM E. RICKER
Indiana University, Bloomington

The writer considers the subfamily Perlinae to include the Perlidae which have the male subanal lobes little modified (not produced into sharp hooks), which have the tenth tergite cleft and the posterior angles of the cleft thickened and produced into forward-pointing processes or "genital hooks," and which have three normal ocelli (Ricker, 1943). A systematic review of the subfamily is badly needed, but since the species are mostly Old World ones, it will probably be done by a student having good access to such material. However, the Old World species currently included in *Perla*, having rather large, simple genital hooks, seem sufficiently different from all American species that the latter should not be included in the type genus. Another fairly distinct group is *Neophasganophora* Lestage (*Phasganophora* Klapálek), which has a single species in America. There is a considerable number of species, including the five discussed in this paper, in which the genital hooks have a large callus or shield ("Schwiele") on the inner side. Whether all such species should be included in one genus is debatable; if so, the genus would include most or all of the species ascribed by Klapálek (1923) to *Paragnetina*, *Tylopyge*, *Togoperla* and *Banksiella*. Whether or not one inclusive genus of this extent should be recognized, the five American species seem to be best contained in a single genus. The genital hooks of all are rather short, not cleft at the tip, and have the callus well developed. They all have a median backward-pointing lobe on the male eighth tergite, though this is quite small in ***kansensis***. In the female, all five species have the subgenital plate slightly to moderately produced, and bearing a small median notch or excavation. Variety appears in the presence or absence of a posterior extension of the male fifth tergite, excavated or bifid at the tip: this is present in ***media***, ***immarginata*** and ***fumosa***, but absent in ***kansensis*** and ***fattigi***. The type species of *Paragnetina* also has such a process. At a subgeneric level a separation of the species lacking it from those which have it would probably be useful, but the matter should be left for a comprehensive revision of the group. Currently our five species are involved in an annoying confusion of specific and generic nomenclature.

Togoperla Klapálek

1907. *Togoperla* Klapálek, Rozpr. Česká Akad. 16 (31): 19 (subgenus of *Perla*).

The use of this name in America was apparently first proposed by Needham and Claassen (1925, p. 286) by inserting it as a subgenus of *Perla* in the list of species at the end of their work, to contain the species ***immarginata*** Say and ***media*** Walker. Frison (1935) accepted

[1]Contribution No. 364 from the Department of Zoology, Indiana University, Bloomington, Indiana.

it as a genus to contain the same two species, and also a "species A" later identified as ***kansensis*** Banks (Frison, 1937). It is impossible to speculate on what factors influenced these authors in choosing ***Togoperla*** as a name for our species, for they have not discussed the matter. However, it does not seem to be a good choice. In 1907 Klapálek described as subgenera both ***Togoperla*** and ***Paragnetina***, the latter a page or two earlier in the paper. In Klapálek's (1923) monograph of the family both names are treated as genera. The type species of ***Togoperla*** is ***limbata*** Pictet, and the type specimen is evidently a female (MacLachlan, 1875). Its subgenital plate is greatly produced, covering the ninth and tenth sternites, and this has no parallel among American species. Also, the genital hooks of male ***limbata*** as illustrated by Klapálek are not at all close to those of any American species. Thus the use of ***Togoperla*** in America rests on considerable uncertainties of association, and should be abandoned in favor of the completely eligible ***Paragnetina***.

Paragnetina Klapálek

1907. *Paragnetina* Klapálek, Rozpr. Česká Akad., 16 (31): 17 (subgenus of *Perla*).

The type species, ***Perla tinctipennis*** MacLachlan from Japan, is illustrated by Klapálek (1923, p. 69). The figure of the female answers well to MacLachlan's description of the type female, and both the male and the female of Klapálek's drawings are very similar to our species ***immarginata***, though of course not so close as to suggest specific identity. It is evident therefore that ***Paragnetina*** is much the best choice of a generic name for American species. When the structure of the type species of ***Togoperla*** is certainly established, that name may either become a synonym of ***Paragnetina***, or may remain in use for a series of species more or less different from the American ones—depending partly on the revisor's tastes.

Banksiana Claassen

1936. *Banksiana* Claassen, Ann. Ent. Soc. Amer. 29: 622 (new name for *Banksiella* Klapálek, preocc.)
1921. *Banksiella* Klapálek, Ann. Soc. Ent. Belg. 61: 147.
1923. *Banksiella* Klapálek, Coll. Zool. Selys-Longchamp, 4(2): 105.

The type of this genus was designated as ***Perla kansensis*** Banks in the original description and in 1923. However, Klapálek's specimen from which he made the generic description was not ***kansensis***, but one of the species having the elongated male fifth tergite, as the description and the 1923 figure both testify. We must therefore associate the name ***Banksiella***, and hence ***Banksiana***, with the ***immarginata-fumosa*** group of species. Thus ***Banksiana*** becomes a synonym of ***Paragnetina*** Klapálek, for these species are very closely related to the type species of ***Paragnetina***, ***P. tinctipennis***. It may be added that even Klapálek had some doubt concerning the identity of his specimen, as shown by the fact that in 1923 the name ***kansensis*** was used with a query following it. I am not certain of the exact identity of the specimen figured by Klapálek in 1923 under the name "***Banksiella kansensis*** (?)." It is most like ***fumosa***, but the tips of the genital hooks are shown as more acute than they are in any specimens at hand.

Eccoptura Klapálek

1921. *Eccoptura* Klapálek, Ann. Soc. Ent. Belg. 61: 60.
1923. *Eccoptura* Klapálek, Coll. Zool. Selys-Longchamps 4(2): 62.

This name requires mention here because its type species, *Perla xanthenes* Newman, was based on a pair of specimens of which the female is of the species now called *Acroneuria xanthenes*, while the male is a *Paragnetina*, very possibly the *P. fattigi* described below, to judge from Klapálek's drawing. Needham and Claassen (1925) followed the practice of authors like Pictet and Hagen in diagnosing the species from the female cotype, and Frison (1942) finally designated the female as lectotype, so that the use of the name *xanthenes* can be considered settled. Regarding the name *Eccoptura*, however, Needham and Claassen (p. 194) say that it was founded by Klapálek on the secondary sexual characters of the male, and, by inference, should apply to the male rather than the female of the two cotypes. Unfortunately Klapálek nowhere appears to express this viewpoint ascribed to him by Needham and Claassen. The original description of *Eccoptura* mentions some characters common to the male and the female, and others peculiar to either sex, with no particular emphasis laid on any of them. The same is true of his key of 1923, which is primarily based on venation. Accordingly, the name *Eccoptura* is to be associated with the species *xanthenes* as now recognized. It thus has priority over *Croconeuria* Needham and Claassen (1925, p. 288), which also has *xanthenes* as type species, though current usage includes either in the genus *Acroneuria* Pictet.

KEY TO NORTH AMERICAN SPECIES OF PARAGNETINA

Males

1a. Fifth abdominal tergite produced posteriorly (fig. 5) 2
1b. Fifth tergite not produced (fig. 1) 4
2a. Produced fifth tergite very shallowly and broadly excavated, or practically straight; genital hooks rounded at the tip ..... **media**
2b. Produced fifth tergite narrowly and deeply notched (fig. 5) 3
3a. Genital hooks produced ventrally into a subacute apical spine ..... **immarginata**
3b. Genital hooks lacking any spine, somewhat angular dorsally (fig. 4) ..... **fumosa**
4a. Seventh abdominal tergite with a tiny lobe on either side of the mid-line, posteriorly; median projection of the eighth tergite about one-fifth of the length of the tergite (fig. 1) ..... **fattigi**
4b. Seventh tergite without appendages; median posterior projection of the eighth tergite minute, about one-fifteenth as long as the tergite ..... **kansensis**

Females (female of *fattigi* unknown)

1a. Subgenital plate merely excavated; membrane of the wings tinted more alongside the veins than elsewhere ..... **immarginata**
1b. Subgenital plate narrowly notched (fig. 2); wings light or dark in color, but not as above 2
2a. Pronotum light brown with a yellow median stripe; ocellar triangle yellow or diffusely brownish ..... **kansensis**
2b. Pronotum dark, without a yellow median stripe; ocellar triangle dark brown or black 3
3a. Pronotum with black margins and black median stripe, the embossed rugosities of a chestnut color; subgenital plate little produced, the base of its median notch in a line with the sides of the hind margin of the sternite, **media**
3b. Pronotum brown, the embossed areas scarcely distinguishable from the rest in color; subgenital plate triangularly produced over nearly half of the ninth sternite, the base of its notch much posterior to the sides of the hind margin of the eighth sternite (fig. 2) ..... **fumosa**

Paragnetina fattigi new species

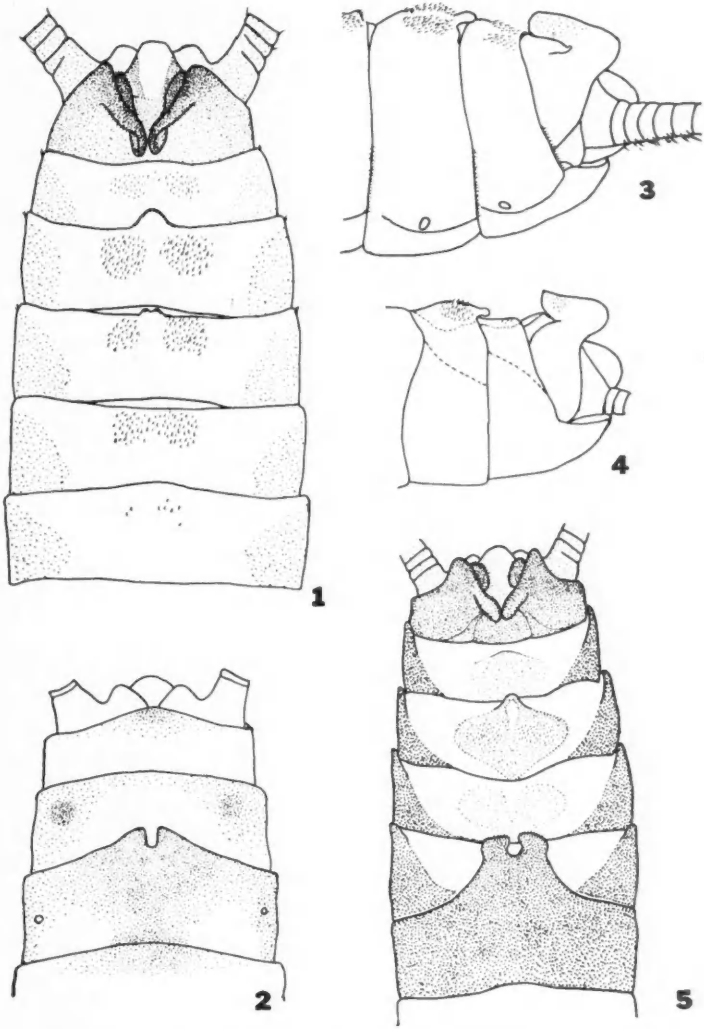
Male.—Length of body 14 mm., to tip of wings 19 mm. General color yellow and light brown. Head light brown, with yellowish M-line and occiput; a darker brown band connecting the anterior ocellus to each lateral one. Pronotum medium brown, the rugosites only slightly darker, the biconcave median field yellow in its posterior two-thirds. Lateral margins of the pronotum darker and bent sharply downward along an oblique line, so that in dorsal view the pronotum appears strongly narrowed behind. Metasternum with a patch of long stout dark hairs. Wings moderately and rather evenly infuscated. Costal cell crossveins four to six; other crossveins absent beyond the cord (except that in the left hind wing of this specimen there are numerous irregularities of venation).

Abdomen with patches of thickened hairs or long spinules centrally on sternites three to seven, the last-named also with shorter heavier spinules. The ninth sternite rather briefly extended posteriorly. Pleurites six to nine have each a terminal row of spinules. Tergites (fig. 1) are unmodified to the fifth, which has a very few spinules. Tergite six has a central patch of spinules posteriorly; tergite seven has two patches of spinules, and bears a pair of minute elevated lobes on its posterior margin medially; tergite eight has two patches of spinules and a median lobe posteriorly whose length is equal to one-fourth that of the sternite somewhat to its side; tergite nine has two patches of spinules (or one patch thinned out on the mid-line) and its hind margin is broadly and very slightly produced medially. The tenth tergite is cleft behind and bears the thickened lobes or genital hooks characteristic of the genus. These are spinulose on their lateral surfaces and also on the callus medially. Supra-anal process rather large, mostly membranous, but weakly sclerotized along a dorsolateral band over its entire anterior portion.

Holotype ♂.—Flat shoals, Concord, Georgia (Flint River, 5.5 miles west), August 1, 1945, P. W. Fattig. (In the collection of the Illinois Natural History Survey.)

This species is closely allied to *Paragnetina kansensis*, from which it is distinguished by the presence of two small lobes on the seventh tergite; by a lobe on the eighth tergite much larger than in *kansensis;* by the presence of a strong row of spinules on the hind margin of pleurites six to nine (*kansensis* has them on eight and nine, very weakly on seven, absent from six); and, in the specimen at hand, by a darker color of head and pronotum.

P. kansensis males have not been taken east of the Appalachians. However, two female specimens that seem to be indistinguishable from *kansensis* have been taken east of the mountains, as follows: Albany, Georgia (Flint River, 1.5 miles south), June 22, 1939, P. W. Fattig (INHS). Jackson Co., Florida (Blue Springs Creek, 3 miles east of Marianna), June 5, 1940, L. Berner (INHS). It would be tempting to regard at least the Georgia female specimen as the female of *fattigi*, since it is from the same river as the holotype. This may well prove to be the case, but both these females are much lighter in color than our *fattigi* specimen, so the association is best left undecided.



Paragnetina fattigi. FIG. 1. Tip of abdomen of ♂ holotype, from above. FIG. 3. The same, from the side.

Paragnetina fumosa. FIG. 5. Tip of abdomen of ♂, Cassville, Ga., June 9, 1945; from above. FIG. 4. The same, from the side. FIG. 2. Tip of abdomen of ♀, Chickamuga Creek, Ringgold, Ga., from below.

The new species is named for Dr. P. W. Fattig of Emory University, Georgia, an enthusiastic and very successful collector of insects of many orders.

Paragnetina fumosa (Banks)

1902. *Perla fumosa* Banks, Canad. Ent. 34: 123.
1907. *Perla fumosa* Banks, Cat. Neur. Ins. U. S., p. 11.
1908. *Perla fumosa* Banks, Trans. Amer. Ent. Soc. 34: 256.
1923. *Phasganophora fumosa* Klapálek, Coll. Zool. Selys-Longchamps 4(2): 96.

The following redescription of the species is from Georgia specimens, with which the types have been checked in all important characters.

Male.—Length of body 12 mm., to tip of wings 16–17 mm. General color dark brown and yellow. Head with the ocellar triangle, the region between the lateral tubercles and M-line, and the clypeus almost black; M-line light brown; region behind compound eyes dusky; occiput and region between ocelli and compound eyes bright yellow. Pronotum dark brown, a very narrow median stripe somewhat lighter; strongly narrowed behind. Mesothorax and metathorax mostly brown above and yellow below; a yellow stripe on the mesonotum; a patch of long stout hairs on the metasternum. Wings quite dark, strongly and evenly infuscated. Costal crossveins three to five, other apical crossveins usually absent.

Abdomen with stout hairs and spinules distributed on sternites three to five as in *P. fattigi*. Terminal spinules on pleurites seven to nine. Fifth tergite produced medially over the whole of segment six, its tip bifid and spinulose. Tergites six to nine with areas of weak sclerotization as in figure 5. Two patches of spinules on tergite eight, and a posterior median lobe; a very few spinules and a trace of a terminal lobe on tergite nine. Tenth tergite raised somewhat in front and near the midline; the genital hooks rather sharply truncate at their anterodorsal extremity, rounded below, with small sparse spinules laterally and a larger denser group on each callus medially. Supra-anal process large, weakly sclerotized anteriorly and laterally, membranous posteriorly.

Female.—Length of body 17–20 mm., to tip of wings 25–28 mm. Similar to the male except in sexual characters, but usually somewhat lighter colored. Eighth sternite with the subgenital plate produced over one-fourth to one-third of the ninth sternite, with a narrow usually straight-walled median notch (fig. 2), the sides of the plate either concave, straight, or convex and sometimes angulate.

Following Needham and Claassen's synonymy of this species with *immarginata* in 1925, it does not appear to have been mentioned in the literature. Dr. Frison (manuscript notes) had studied the types, and had a few similar specimens in his collection, but considered them as a small dark southern form or race of *immarginata*. There is no question concerning the similarity of *fumosa* to *immarginata*, but there are also considerable differences: smaller size; darker, uniformly smoky wings; genital hooks without terminal ventral projections as in *immarginata*; and a more narrowly notched female subgenital plate. The general ranges of the two species are known to overlap from Virginia through Georgia (though the exact localities may not), and I have detected no overlapping in the morphological features mentioned above.

The known range of *Paragnetina fumosa* is from the District of Columbia south to Georgia and Alabama. Material examined is as follows. ALABAMA: Kushla, Mobile Co. (Seabury Creek, 1.4 miles south), June 3, 1940, ♂, L. Berner. DISTRICT OF COLUMBIA: Washington, ♂ ♀ (types). GEORGIA: Atlanta (Nancy Creek, 8 miles north), June 26, 1945, ♀, P. W. Fattig. Cassville (Clear Lake, 3.5 miles north), June 9, 1945, ♂, P. W. Fattig. Dahlonega (Caneck Falls, 3 miles north), July 31, 1945, ♀, P. W. Fattig. Forsyth (Towaliga River, 6.4 miles north), Sept. 15, 1945, ♂, P. W. Fattig. Perry (Mossy Creek, 4.6 miles north), May 13, 1939, 2♂; Sept. 7, 1945, ♂, P. W. Fattig. Ringgold (Chickamuga Creek), June 19, 1939, 2♀, P. W. Fattig. Thomaston (Whispering Pines, 12 miles south), June 8, 1939, ♀, P. W. Fattig.

Paragnetina immarginata (Say)

1823. *Sialis immarginata* Say, Godman's Western Quarterly Reporter 2: 164.
1861. *Perla immarginata* Hagen, Synop. Neurop. N. Amer., p. 20.
1913. *Perla immarginata* Smith, Ann. Ent. Soc. Amer. 6: 203–211.
1925. *Perla immarginata* Needham and Claassen, Monogr. Plecop. N. Amer., pp. 102, 317, 329. (Description and figures of ♂ ♀).
1931. *Perla immarginata* Claassen, Plecop. Nymphs N. Amer., pp. 50–53, 135, 187. (Description and figures of nymph.)
1944. *Togoperla immarginata* Ricker, Canad. Ent. 76: 184.
1947. *Paragnetina immarginata* Ricker, Trans. Royal Canadian Inst. 26(2): 407.
1861. *Perla lurida* Hagen, Syn. Neurop. N. Amer., P. 21.
1909. *Acroneuria lurida* Klapálek, Bull. Internat. Acad. Sci. Boheme 18: 51.
1917. *Acroneuria lurida* Klapálek, Časopis České Společnosti Ent. 14: 45.
1923. *Perla lurida* Klapálek, Coll. Zool. Selys-Longchamps 4(2): 52.
1935. *Acroneuria fumosa* Ricker, Canad. Ent. 67: 262.

In deciding what species of stonefly Say described under the name *immarginata*, the usage of Smith (1913) and Needham and Claassen (1925) seems unexceptionable. Say's phrase "wings obscure, veins fuscous, immarginate" presumably means "wings somewhat smoky (not clear hyaline); the veins dark; the membrane immediately alongside the veins darker than elsewhere." This describes very well the wings of the *immarginata* of Needham and Claassen. Indeed it is difficult to think of any other species "more than an inch long" answering to this description; certainly not the *Acroneuria* placed here by Klapálek (1909, 1923; see Ricker, 1938). To confirm present usgae I am selecting the following types.

Neotype ♂: Ithaca, N. Y., Sep. 9, 1889, Cornell University Collection. Neallotype ♀: The same, Sep. 28, 1907.

It should be mentioned that Banks has usually or always treated this species under the name *Perla coulonii* Pictet, as shown by a long series of specimens so labelled in the Museum of Comparative Zoology. This association of Pictet's name may well be correct, though the description is not entirely unambiguous; however, Say's name is an older one. Banks' use of *immarginata* probably refers to some *Acroneuria* which "lacks a dark eye spot."

Needham and Claassen (1925) did not distinguish *fumosa* Banks from *immarginata* Say, so either of their two southern records of *immarginata* might possibly pertain to *fumosa*. One of them I have checked and found accurate (Tallulah Falls, Georgia). Indeed none of the specimens

now in the Cornell Collection labelled *Perla immarginata* can be assigned to *fumosa*, though three females recorded by Needham and Claassen from Niagara Falls prove to be *P. media*.

Regarding Hagen's *Perla lurida*, a recent examination of the female holotype from New Orleans, in the Museum of Comparative Zoology at Cambridge, shows that it is indistinguishable from *immarginata* in color and structure of the subgenital plate. (Say's *immarginata* was known to Hagen only from the description.) The same identity of structure exists in respect to the female, also from New Orleans, determined as *lurida* by Klapálek (1909, 1923). Frison (1942) has stated that the type of *lurida* is probably the species currently being called *Acroneuria carolinensis* Banks. What suggested this is apparently the fact that the notch in the subgenital plate of the type specimen is somewhat larger than in most specimens of *immarginata*, though it is smaller than in most *carolinensis*. However, the color of the wings and their large size is sufficient to show that this type is not *carolinensis*, and the pattern of the pronotum provides additional evidence of the same. Consequently *lurida* must be regarded as a synonym of *immarginata*, unless the discovery of males from the New Orleans region will show that another closely related species is involved.

The known range of *Paragnetina immarginata* is from the James Bay region of Quebec southward and eastward through eastern Ontario, Quebec and the maritime provinces of Canada, New England, New York, western Pennsylvania, and in the hills to the Carolinas and Georgia. The New Orleans specimens mentioned above would extend this range southwestward, but a confirmation of the exact locality involved would be very desirable. Several Canadian locality records have been published in the two papers of Ricker, cited above, and others are to appear. Specimens in the Cornell University collection (CU) and the Illinois Natural History Survey (INHS) are listed below. Howell, (1939, 1941) has published records of nymphs from various localities in North Carolina.

Material examined.—GEORGIA: Cleveland (Chestatee River, 12 miles north), July 7, 1945, ♀, P. W. Fattig. Taccoa, July 17, 1910, ♂, J. C. Bradley (CU). Tallulah Falls, June 21, 1909, ♂, J. C. Bradley (CU). NEW YORK: Frecks, Alleghany State Park, August 11, 1926, ♂, S. C. Bishop (CU). Groton, September 5, 1928, ♂, P. R. Needham (CU). Hamilton Co., ♂, (CU). Ithaca, August 11, 1884, ♂; September 9, 1889, ♂; September 24, 1889, ♂; August 5, 1890, ♂, R. H. Pettit; August 5, 1896, ♂; September 28, 1907, ♀; July 23, 1912, ♂, R. W. Leiby; July 22, ♀, T. L. Hankinson; August, ♀; no date, ♀ (all CU). Ithaca (Fall Creek), July 15–21, ♀, F. C. H. (CU). Keene Valley, Beede's, August, ♀ (CU). Ludlowville, ♂ (CU). Mount Whiteface (2000–4000 feet), August 23, 1916, ♂ (CU). Wells, August 30, 1930, ♂ (CU). Wilmington, Essex Co., August 11, 1888, ♂; August 22, 1916, ♂ (CU). NORTH CAROLINA: No locality, ♂ (CU). Black Mts., June, 1912, ♂, Beutenmuller (CU). PENNSYLVANIA: Elk Grove, September 9, 1909, ♀; September 8, 1919, ♀; W. T. Davis (CU). Red Rock, Luzerne Co., September, 1909, ♂, W. T. Davis (CU). SOUTH CAROLINA: Oconee Co., C.C.C. Camp F2, August 22, 1936, ♂, F. Sherman (INHS). WEST VIRGINIA: Wardensville, August 14, 1930, ♂ (CU).

Paragnetina kansensis (Banks)

1905. *Perla kansensis* Banks, Psyche 11: 56.
1925. *Perla kansensis* Needham and Claassen, Monogr. Plecop. N. Amer., pp. 99, 329. (Description and figures of ♂, ♀.)
1935. *Togoperla* sp. A. Frison, Illinois Nat. Hist. Surv. Bull. 20(4): 414–416. (Description and figure of nymph.)
1937. *Togoperla kansensis* Frison, Ibid., 21(2): 82. (Figures of ♂, ♀.)

Apparently specimens belonging to this species have always been correctly recognized, though the name has twice been applied to other species. The first of these was by Klapálek (1923), as described under *Banksiana* above. The second was by Dr. P. W. Claassen, who determined the male cotype of *Perla xanthenes* Newman, from Georgia, as *kansensis* (quoted by Ricker, 1938). The discovery of *fattigi* makes it probable that this cotype is really the latter species, but even so, Dr. Claassen's identification was eminently reasonable at the time.

P. kansensis is known only from Kansas, Illinois and Indiana. In addition to the Indiana and Illinois specimens listed by Frison (1937), there is in the Illinois Natural History Survey a female specimen from Douglas County, Kansas.

Paragnetina media (Walker)

1852. *Perla media* Walker, Cat. Neur. Br. Museum, Pt. I, p. 145.
1861. *Perla media* Hagen, Syn. Neur. N. Amer., p. 24.
1923. *Phasganophora media* Klapálek, Cat. Coll. Zool. Selys-Longchamps 4(2): 95. (See Ricker, 1938, for a discussion of the illustrations.)
1925. *Perla media* Needham and Claassen, Monogr. Plecop. N. Amer., pp. 103–104, 317, 329. (Description and figures of ♂, ♀.)
1931. *Perla media* Claassen, Plecop. Nymphs N. Amer., pp. 48–50, 157, 191. (Description and figures of nymph.)
1935. *Togoperla media* Frison, Bull. Illinois Nat. Hist. Surv. 20(4): 327, 412–414. (Figures of ♂, ♀, nymph.)
1938. *Togoperla media* Ricker, Trans. Roy. Canadian Inst. 22(1): 141.
1944. *Togoperla media* Ricker, Canad. Ent. 76: 184.
1947. *Paragnetina media* Ricker, Trans. Royal Canadian Inst. 26(2): 407.
1935. *Acroneuria salvelini* Ricker, Canad. Ent. 67: 261.

There seem to be no taxonomic problems outstanding that concern this species. It has a chiefly northern distribution, being known from northern Saskatchewan, northern Ontario and central Quebec, south to Minnesota, Wisconsin, extreme northern Illinois, southern Michigan, central Pennsylvania and southern New England. In the Appalachians it has been collected south to Virginia and North Carolina, and Dr. H. H. Ross found it in the Ozark region of southern Missouri. It is very common in the warmer brooks and rivers of the southern Ontario uplands, but absent there from the colder of the trout streams. Canadian records can be found in the writer's papers cited above, while Needham and Claassen (1925) and Frison (1935) have United States records.

The following new United States records are from the Illinois Natural History Survey collection, determined by Dr. T. H. Frison. It has proved impossible to cite individually the numerous collections from Minnesota, Wisconsin, Michigan, and New York. The majority were collected by Dr. Frison himself or by his associates, Drs. H. H. Ross, B. D. Burks, and Carl Mohr; Drs. J. W. Leonard, F. E. Lyman, D. Denning, P. Jennings and others sent in a considerable number of specimens.

Material examined.—CONNECTICUT: Cornwall, Housatonic River, May 30, 1941, ♀, P. J. Jennings. Mt. Carmel (Mill River at Sleeping Giant), June 9, 1936, ♂, nymphs, K. M. & A. H. Sommerman. MARYLAND: Little Gunpowder Falls, near Jappa, nymph, T. H. Frison. Hagerstown, Marsh Run Creek, nymph, T. H. Frison. MICHIGAN: Adults from Crawford Co., June 16–17; Lake Co., June 5; Montmorency Co., July 2–15; Muskegon Co., May 29. Nymphs from the following counties of the Lower Peninsula: Benzie, Branch, Cheboygan, Gladwin, Iosco, Kalamazoo, Kent, Lake, Mason, Montcalm, Muskegon, Ogemaw, Oscoda, Otsego, Presque Isle, Tuscola; and from three in the Upper Peninsula: Delta, Mackinac, Ontonagon. MINNESOTA: Adults from Anoka Co., May 15; Hennepin Co., June 7; St. Louis Co., June 27. Nymphs from Benton, Cook, Hubbard, Lake, and Scott Counties. MISSOURI: Green Springs, Oregon Co., June 7, 1937, 4♂ 1♀, H. H. Ross. NEW YORK: Adults from Ithaca, Tompkins Co., June 10, and from Niagara Falls. Nymphs from Delaware, Dutchess, Hamilton, Livingston, Putnam, and Westchester Co. NORTH CAROLINA: Hot Springs, Madison Co. (French Branch River), June 15, 1935, 1 exuvia, H. H. Ross. Highlands, Macon Co., August, 1943, ♀, T. Howell. PENNSYLVANIA: Beavertown, Snyder Co., Middle Creek, June, 1939, 1♂, 12 nymphs, C. M. Wetzel. Monroe Co., Marshall's Creek, May 24, 1935, 1 nymph, W. J. Harmer. Stoddardsville, Luzerne Co., Lehigh River, June 4, 1938, ♀, P. Jennings. VIRGINIA: Mountain Lake, Giles Co., Little Story Creek, July 4, 1939, 5 nymphs, J. S. Rogers. WISCONSIN: Adults from Adams Co., June 5; Iron Co., Aug. 9; Lincoln Co., June 18 to July 2; Price Co., June 18; Vilas Co., July 3–22; Sawyer Co., June 30 to July 6; Washburn Co., June 5–6. Nymphs from Bayfield, Douglas, Oneida, Polk, and Waushara Counties.

REFERENCES

Frison, T. H. 1935. The stoneflies, or Plecoptera, of Illinois. Illinois Nat. Hist. Survey Bull. 20(4): 281–471.

1937. Descriptions of Plecoptera. *Ibid.* 21(3): 78–99.

1942. Studies of North American Plecoptera with special reference to the fauna of Illinois. *Ibid.* 22(2): 233–355.

Howell, Thelma. 1939. Extended ranges of some aquatic insects in North Carolina. J. Elisha Mitchell Sci. Soc. 55(2): 320–328.

1941. Some aquatic insects from the Great Smoky Mountains National Park. J. Tennessee Acad. Sci. 16(4): 406–407.

Klapálek, F. 1907. Ueber die Arten der Unterfamilie Perlinae aus Japan. Česká Akad., Bull. Internationale 12: 257–274. Czech text in Rozpr. Česká Akad. 61(31): 1–28.

1909. Revision der Gattung *Acroneuria* Pict., Česká Akad., Bull. Internationale 14: 234–247. Czech text in Rozpr. Česká Akad. 18(5): 1–21.

1923. Plécoptères II. Fam. Perlidae. Collections Zool. du Baron Edm. de Selys-Longchamps 4(2): 1–193.

McLachlan, Robert. 1875. Perlidae. *In* A sketch of our present knowledge of the neuropterous fauna of Japan. Ent. Soc. London, Trans. 1875: 171–173.

Needham, J. G., and **R. W. Claassen.** 1925. A monograph of the Plecoptera or stoneflies of America north of Mexico. Ent. Soc. America, Thos. Say Foundation 2: 1–397.

Ricker, W. E. 1938. Notes on specimens of American Plecoptera in European collections. Royal Canadian Inst., Trans. 22(1): 129–156.

1943. Stoneflies of southwestern British Columbia. Indiana University Studies, Sci. Ser. 12: 1–145.

TROMBICULID MITES AFFECTING MAN
IV. REVISION OF EUTROMBICULA IN THE AMERICAN HEMISPHERE

DALE W. JENKINS
Medical Division,
Army Chemical Center, Maryland

This paper is an attempt to clarify the status of the medically important chigger mites known to attack human beings in the American hemisphere. In the course of investigations on the rearing of mites causing trombidiosis of human beings, identification of the species proved to be very difficult or impossible. These species form a group having similar morphological and physiological characteristics, but they have been placed in many genera including *Trombicula*, *Eutrombicula*, *Trombiculoides*, and *Acariscus*. Many of the species of this group were insufficiently defined, and at the beginning of the writer's study 25 species had been named by Italian, Dutch, German, English, Spanish, Portuguese, French, and American authors. As a reult of making collections in tropical and temperate areas, examining the type specimens of eighteen species, and rearing nine kinds in the laboratory, thirteen of the species were found to be synonyms, leaving only six recognizable species and one subspecies. These mites are placed in the subgenus *Eutrombicula* of the genus *Trombicula*. Five insufficiently described species are of uncertain status since suitable specimens were not available for study.

Genus **Trombicula** Berlese, 1905

The genus is based on an inadequately described adult mite from Java, *Trombicula minor* Berlese (1905), which was thought to be a nymph until Willman (1941) redescribed it. The adult appears to be similar to adults of *Eutrombicula*; however, the species has not been reared or definitely correlated with any larvae. Since the majority of trombiculid mites are known only in the larval stage, the use of *Trombicula* is somewhat speculative. The genus *Trombicula* has been divided into a number of closely related genera including *Eutrombicula* Ewing, 1938. These various genera are considered here to be subgenera of *Trombicula*.

Subgenus **Eutrombicula** Ewing, 1938

Type, *Microthrombidium alfreddugèsi* Oudemans, 1910, by original designation.

Eutrombicula Ewing, 1938, J. Wash. Acad. Sci. 28: 291. Radford, 1942, Parasitology 34: 66. Vitzthum, 1942, Bronns Klassen und Ordnungen des Tierreichs, Bd. 5, Abt. IV, Buch 5: 829. Ewing, 1943, Proc. Ent. Soc. Wash. 45: 57. Ewing, 1944, J. Parasit. 30: 346. Finnegan, 1945, Brit. Mus. (Nat. Hist.) Econ. Ser. 16: 14, 58. Wharton, 1945, J. Parasit. 31: 401. Taylor, 1946, Comm. Aust. Serv. 6: 147. Michener, 1946, Ann. Ent. Soc. Amer. 39: 104, 432. Ewing, 1946, J. Parasit. 32: 437. Jenkins, 1947, Ann. Ent. Soc. Amer. 40: 56. Jenkins, 1948, Amer. Jour. Hyg. 48: 22, 36.

Acariscus Ewing, 1943, Proc. Ent. Soc. Wash. 45: 57.—Genotype *Trombicula flui* Van Thiel, 1930. Ewing, 1944, J. Parasit. 30: 347. Wharton, 1945, J. Parasit. 31: 401. Michener, 1946, Ann. Ent. Soc. Amer. 39: 104, 432. Ewing, 1946, J. Parasit. 32: 439. Jenkins, 1949, J. Parasit. 35: 201.

The subgenus ***Eutrombicula*** Ewing is here redefined on the basis of both larval and adult characters.

Larva

Body.—Shape evenly rounded to slightly elongated posteriorly. Length 0.15 to 0.25 mm. unengorged to 0.3 to 0.6 mm. in fully engorged specimens. Color red to reddish-orange, rarely white. Body covered with numerous transverse striae. On each side of the scutum is an ocular plate bearing two eyes. The anterior eyes are larger and have horizontal lenses; the posterior eyes are smaller and the lenses are almost vertical in position. The anus is located posteriorly on the ventral surface of the body. A dorsal and ventral view of the larva is shown in Fig. 1.

Gnathosoma.—Palpi with coxae and trochanters fused forming a ventral plate bearing a pair of four- to eight-branched setae. The palpal femur is rounded laterally and bears a dorsal lateral seta with three to seven branches; genu with a dorsal median seta with no to five branches; tibia with a ventral seta with no to five branches and a nude dorsal and a nude lateral seta. The tibia bears a terminal palpal claw with two prongs, of which the outer prong is the largest and longest; the inner slightly ventral prong is smaller and is located from one-half to three-fourths the length from the base. Palpal tarsus with two nude and seven plumose setae. The galeal setae are nude. The cheliceral bases are punctate dorsally. The chelicerae are flat and blade-like, concave dorsally, with a tricuspid cap at the apex; the ventral process of the cap is a narrow posteriorly directed tooth and the dorsal process appears as a flap-like process. No stigmata or tracheal trunks are found laterad to the gnathosoma.

Legs.—In all three pairs, each leg has seven segments which are somewhat punctate and bear setae. A pit-like urstigma lies in an excavation of coxa I near coxa II. Coxa III is removed posteriorly from coxa II. Legs I, II, and III have the coxae and trochanters each with one ventral plumose seta, basifemurs and telofemurs each with several plumose setae and no nude or specialized setae. Genua, tibiae, and tarsi each with branched plumose setae and other setae as follows. Leg I: genu with three nude setae and a short spine, tibia with two nude setae and a short spine, tarsus with a heavy curved striated nude seta, a short spine, and two nude setae, pretarsus with one nude seta; leg II: genu with one nude seta, tibia with two nude setae, tarsus with a short spine and a heavy curved striated nude seta, pretarsus with one nude seta; leg III: genu with one curved nude seta, tibia with one curved nude seta, tarsus with one long nude whip-like seta. (In *T. multisetosa* and *T. batatas*, the tibia bears one short curved nude seta and two long nude whip-like setae; tarsus with three long nude whip-like setae.) At the apex of each leg are three claws, the central one longer and blade-like. Figures 1 and 3 show the typical chaetotaxy of the legs of the subgenus.

Scutum.—Size comparatively large, punctate, and more or less rectangular in shape, often with a convex posterior margin. Five barbed setae are located one at each corner and one at the anterior median position. A pair of circular sensillary bases is found in the central submedian area, from each of which arises a single flagelliform sensillum having the proximal half nude and the distal half four- to

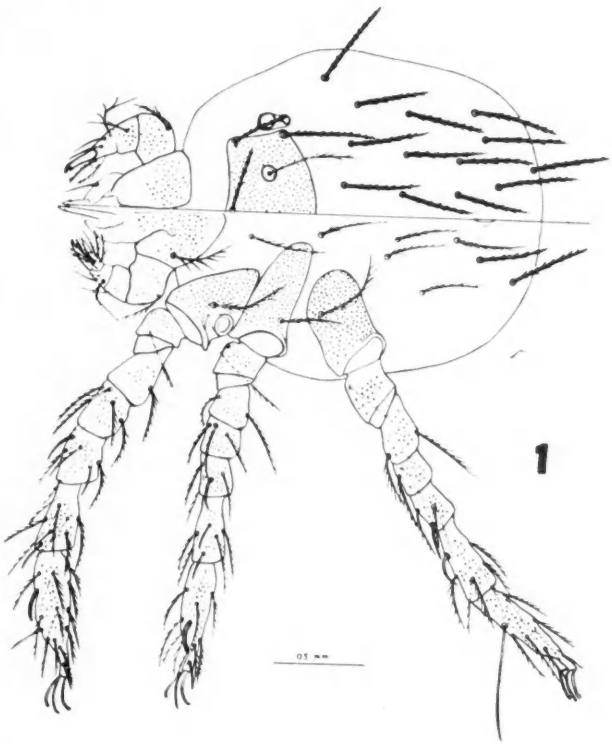


FIG. 1. Larva of *Trombicula splendens*, dorsal view above, ventral view below. (Legs rotated beyond coxae.)

nine-branched. The average standard measurements of the scutum of American hemisphere species are presented in Table I.

Setae.—The dorsal setae, including the humeral and posterior caudal and marginal setae, are 22 to 68 (to 54 in American species) in number, and are arranged in rows 2–12–12+, 2–10–10+, 2–8–8+, or 2–6–6+. The dorsal setae and all setae lateral and posterior to the anus are thick and barbed, 30 to 55 μ in length. The ventral setae are 14 to 46 (in American species) in number. Two pairs of sternal setae are located

between the coxae; six ventral setae are disposed roughly in the shape of an M followed posteriorly by a pair anterior to the anus, arranged as 2–2–6–2+. The ventral setae are thin, flagelliform, finely-branched, and usually shorter than the barbed dorsal setae. The thicker barbed setae of the dorsal type found lateral and posterior to the anus are counted as ventral setae since they are on the ventral surface. The body setae on the posterior surface (caudal and marginal) are counted as dorsal setae, even though their position is somewhat variable depending upon engorgement and mounting technique.

Adult

Body.—Shaped somewhat like a figure eight, a constriction slightly anterior to the middle of the body. Length 0.7 to 1.6 mm., width 0.5 to 0.9 mm. Color brilliant red. Body densely covered with plumose setae.

Gnathosoma.—Palps bearing relatively few setae, femur with one inner median seta and two to four distal inner setae, tibia with a small papilla arising from the inner distal surface and bearing three strap-shaped ctenidial setae. A longer sharply pointed flat ctenidial seta arises at about the middle of the dorsal margin. Tibia with one to three setae on inner surface at tarsal articulation. Palpal claw with a rounded swelling at base of concave margin; length of claw 0.52 to 0.66 times length of tibia. Tarsus with many branched setae and with three to five or seven to fourteen simple apical setae. Chelicerae with dorsal margin serrate.

Legs.—Four pair of six-segmented legs, of which the anterior pair I is longest, and with enlarged tibia and tarsus. Length of tarsus I, 2.0 to 2.8 times its width, and 1.2 to 1.6 times length of tibia I. All tarsi with two claws each. Coxae I and II fused together forming a plate, coxae III and IV located more posteriorly and joined together at constriction of body.

Scutum.—Length of scutum 120 to 210 μ from anterior end of crista to posterior lobes of dorsal saddle over the sensillary area. Anterior to the crista is an epistome bearing one heavily branched plumose seta. The crista is slender and tube-like, broadened posteriorly into an expanded sensillary area containing a rather short median carina which extends into the crista a short distance. Lateral to the sensillary area is a pair of sensillary bases, each bearing a flagelliform sensilla 130 to 250 μ in length, and from three- to six-branched in the distal half. The width between the sensillary bases is from 38 to 74 μ. A bridge-like dorsal saddle spans the sensillary area between the sensillary bases as shown in Fig. 12. The saddle has a concave anterior margin and a biconvex posterior margin forming two prominent lateral lobes or crests, sometimes connected. The sensillary area is narrowed posteriorly into a single apodeme. The convex eye lobes are located postero-lateral to the sensillary bases. Diameter of eyes from 0.2 to 1.0 times the distance between the lateral margins of the sensillary bases.

Setae.—Body setae heavily branched, bright red in color. Length of longest lateral humeral setae from 0.4 to 0.8 times length of longest posterior body setae which measure 36 to 76 μ in the short non-

attenuated type, to 138 μ in the attenuated type. The apices of the setae are not expanded.

Genitalia.—A pair of kidney-shaped genital plates is located medially on the ventral surface of the body posterior to coxae IV. Three elliptical or rounded genital suckers are found on each plate. The males have a genital papilla on each genital plate, each papilla bearing four large fan-like flattened genital setae with the posterior borders heavily fringed as shown in Fig. 14. The penis is large and oval, somewhat egg-shaped, bearing four pairs of short simple penile setae. The females do not have genital papillae on the genital plates, but have in their place a row of three or more nude genital setae as shown in Fig. 15. A pair of small genital rings (sacculi) is located between the genital plates. An oval anus is located posterior to the genital area.

This group of species was first referred to by Ewing (1937) as the *irritans* group of the genus *Trombicula*. The group was composed of larvae having the palpal claw with two prongs and having plumose sensillae. The generic name *Eutrombicula* was proposed for this group by Ewing (1938) and was described as follows: "Chelicerae each with a single dorsal tooth. Palpal claws bifurcate. Eyes present. Dorsal plate with posterolateral corners, without anterior median process, without crista. Median seta of dorsal plate present, barbed; anterolateral setae with barbs; submedian setae absent; total number of setae on dorsal plate (exclusive of pseudostigmatic organs) five, all marginal. Pseudostigmatic organs setiform or flagelliform, with or without barbs. Dorsal abdominal setae usually less than 30, barbed, arranged in more or less irregular transverse rows. Legs and tarsal claws typical for the subfamily *Trombiculinae*." Ewing designated the type species as *Microthrombidium alfreddugèsi* Oudemans and included 19 species in the genus.

Eutrombicula was revised by Ewing (1943) when the genus *Acariscus* was separated as follows: "Dorsal abdominal setae (counting the posterior marginal pair) 22, and arranged, previous to engorgement, as follows: 2–6–6–4–2–2; ventral body setae (counting the 4 sternals, but not counting the 2 posterior marginals) 14, arranged as follows: 2–2–6–2–2." The genus was again redefined, (Ewing 1946b), and the above descriptions combined. The dorsal setal number and arrangement was emphasized.

The genus *Acariscus* was described to include species with more than 22 dorsal abdominal setae and more than 14 ventral setae. The type species was *Trombicula flui* Van Thiel, and 10 species were included in the genus. Womersley (1944) and Womersley and Kohls (1947) did not accept *Acariscus*. Wharton (1945b) described two new species of *Acariscus* but indicated that the genus was not well defined from *Eutrombicula*. Michener (1946a) considered *Acariscus* a synonym, and pointed out the discovery of a new species in Panama, *Trombicula* (*Megatrombicula*) *attenuata* Michener (1946b) with 24 dorsal setae which was said to bridge the gap between *Eutrombicula* with 22 setae, and *Acariscus* with 26 or more setae. This species cannot be considered, however, since it belongs in an entirely different group (*Mega-*

trombicula). Ewing (1946a and 1946b) reaffirmed *Acariscus* and Michener (1946c) refuted it.

Acariscus is here considered a synonym of the subgenus *Eutrombicula* since *Acariscus masoni* larvae were reared by Jenkins (1949) to adults of the previously described *Trombicula* (*Eutrombicula*) *splendens*. Furthermore these larvae sometimes have 24 dorsal setae, appearing to intergrade with *T. alfreddugèsi* in this character, so that no distinctive differences remain to validate *Acariscus*.

Trombiculoides was founded as a new genus by Jacot in 1938 on adults which he considered the same as *Trombidium scabrum* Say 1821. In 1946, Ewing considered *Trombiculoides* a synonym of *Sericothrombium* Berlese. Wharton (1948) re-examined Jacot's types and found them closely related to *T. alfreddugèsi*. On the basis of measurements of the types made by Wharton, and furnished to the present author, these adults are typical *T. splendens*. *Trombiculoides* Jacot, 1938, is considered a genus of doubtful status. Wharton (1948) has presented this case to the International Commission on Zoological Nomenclature for decision under Opinion 168.

In *Trombicula sensu lato* of authors for larvae, there is a complete intergradation in the reduction of one of the two small exterior prongs of the palpal claw to only one, as stated by Michener (1946a, c). It is proposed that species previously placed in *Eutrombicula* and *Acariscus*, with two prongs on the palpal claw, the outer of which is smaller, be referred to *Trombicula sensu lato*.

Several series of morphological changes of an orthogenetic type are observed in the members of this subgenus. There appears to be a reduction series in the number and branching of the dorsal and ventral setae in the larvae, from *T. multisetosa* to *T. alfreddugèsi*, as shown in Table I. Of the species with 22 dorsal setae, there is a reduction in the branching of palpal setae from *T. tinami* with all setae four- to six-branched to species with the palpal genual and ventral tibial setae nude. There is also a reduction in the number of long nude setae on tibia and tarsus III.

Five of the seven species and subspecies recognized in the American hemisphere have been observed or recorded to attach to human beings and to cause an inflammatory reaction. In addition to these *Eutrombicula* species, the following have been recorded to attack human beings in the American hemisphere. *Euschöngastia nuñezi* (Hoffmann) in Mexico, *E. guyanensis* (Floch & Abonnenc) and *Trombicula canis* Floch & Abonnenc, in French Guiana, and *T. landazuri* Boshell & Kerr in Colombia.

The common names given to the mites affecting man are quite different in the various countries, and the author has heard most of the following names (among others) used for the larvae of *Eutrombicula*: United States—"chiggers" (northern states), "red bugs" (southern states); Mexico—"tlalzahuatl," "aradores," (Yucatan) "coloradillo"; Guatemala—"aradores"; Honduras—"coloradilla," "pobladores," "ciron"; Costa Rica—"coloradilla"; Panama—"bicho colorado," "coloradilla," "coloradita," "cuscusa"; Cuba—"colorado," "bicho colorado"; Martinique—"bete rouge"; Barbados—"potato louse"; Trinidad—"grass louse"; Colombia—"yaya," "cuitiva," "niabi"; Venezu-

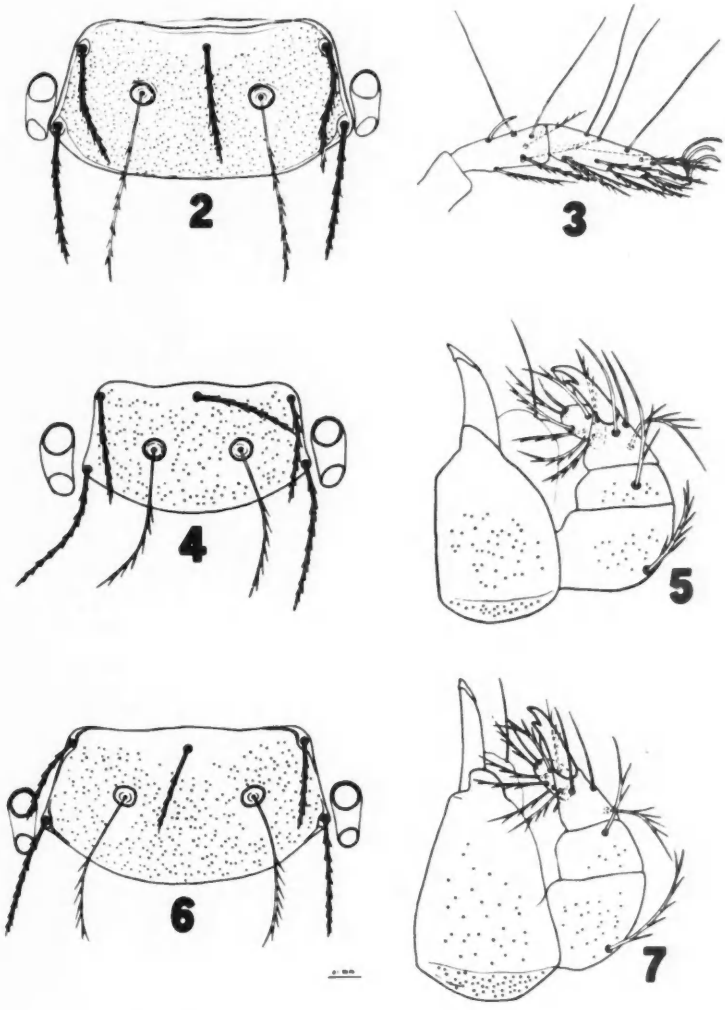


FIG. 2. Scutum of *Trombicula multisetosa* larva. 3. Tarsus III and tibia III of *T. multisetosa* larva. 4. Scutum of *T. batatas* larva. 5. Dorsal view of right palp of *T. batatas* larva. 6. Scutum of *T. alfreddugèsi* larva. 7. Dorsal view of right palp of *T. alfreddugèsi* larva. (Figures 2 and 7 are all drawn to the same scale.)

ela— "chivacoa," (Rio Orinoco) "coloradilla"; French Guiana—"pou d'agouti"; Dutch Guiana—"pou patate," "pattata"; Brazil—"mouqui" (Para) "mucuim"; Ecuador—"garrapatilla"; Peru—"japa," "mucuim," "inacua"; Uruguay—"bicho colorado"; Argentina—"bicho colorado."

In the following larval key, the dorsal setae refer to the total number including the two humeral setae, the posterior caudal and posterior marginal setae. The ventral setae include the two pairs of sternal setae between the coxae, the ventral abdominal setae, and the dorsal type setae posterior to the anus on the ventral surface. The posterior caudal and marginal setae shift position dependent upon engorgement so that total number of dorsal and ventral setae may have to be considered. In Table I, the standard measurements of the scutum and length of dorsal setae are abbreviations as defined by Wharton (1945a) and Brennan (1947).

TABLE I

LARVAL CHARACTERISTICS AND MEASUREMENTS

	multi-setosa	*batatas*	*splen-dens*	*alfred-dugesi*	ssp. *tropica*	*tinami*	*goldii*
Number of dorsal setae	50–54	32–36	26 (24)	22	22	22	22
Number of ventral setae	42–46	22	16	14	14	16	16
Prong of pedipalpal claw (from base)	3/4	3/4	3/4	3/4	3/4	1/2	1/2
Number of branches of palpal seta:							
Coxal	6–7	8	6–7	4–7	4–6	4–5	4–5
Femoral	4–6	4–6	4–6	4–6	4–5	6–7	4–6
Genual	1–2	1–3	0–3	0–3	0	4–5	0
Ventral tibial	2–4	2–5	3–4	1–4	0	4–5	0
Number of long nude hairs on tarsus III	3	3	1	1	1	1	1
Number of long nude hairs on tibia III	2	2	0	0	0	0	0
Standard measurements (ave. in μ):							
AW	79	64	78	81	79	77	77
PW	93	71	91	90	86	92	91
SB	39	27	44	43	45	45	42
ASB	23	21	22	23	21	29	21
PSB	29	25	32	31	31	35	32
AP	26	23	27	27	24	38	28
AM	38	29	37	33	35	58	44
AL	38	31	34	33	35	51	40
PL	48	43	48	45	48	63	51
S	52	52	51	50	48	56	56
DS	44	37	49	42	45	56	49
Number measured	(4)	(8)	(10)	(18)	(3)	(2)	(12)
Attach to man	yes?	yes	yes	yes	yes	no	yes

KEY TO AMERICAN TROMBICULA (EUTROMBICULA) LARVAE

A. Dorsal setae 32 to 54 in number; tibia III with one short curved nude seta and two long nude whip-like setae; tarsus III with three long nude whip-like setae.

B. Dorsal setae 50 to 54, heavily barbed; ventral setae 42 to 46; sensillae with many short appressed branches..... **multisetosa**

BB. Dorsal setae 32 to 36, lightly barbed; ventral setae 22; sensillae with 5 to 7 spreading branches..... **batatas**

AA. Dorsal setae 20 to 26; tibia III with one short curved nude seta; tarsus III with one long nude whip-like seta.
B. Total dorsal and ventral setae 42; dorsal setae 26 (rarely 24) arranged 2–6–6–4–4–2–2; ventral setae 16. . . . . **splendens**
BB. Total dorsal and ventral setae 36 or 38; dorsal setae 22 or 20 depending upon engorgement.
C. Palpal claw with a small inner prong about half the distance from the base; total setae 38, ventral setae 16 arranged 2–2–6–2–2–2.
D. All palpal setae four- to seven-branched; scutal setae relatively long. . . . . **tinami**
DD. Palpal genual and ventral tibial setae nude; genual seta long, about 28 μ in length. . . . . **göldii**
CC. Palpal claw with a nearly equal sized subapical inner prong, about three-fourths the distance from the base; total setae 36, ventral setae 14, arranged 2–2–6–2–2.
D. Palpal ventral tibial setae always branched, palpal genual setae usually branched. . . . . **alfreddugèsi**
DD. Palpal ventral tibial and genual setae always nude, genual seta about 20 μ in length. . . . . **a.** ssp. **tropica**

TABLE II

ADULT CHARACTERISTICS AND MEASUREMENTS

	batatas	*splendens*	*alfred-dugesi*	*göldii*	*coarctata*
Length, mm	0.7–1.0	0.9–1.4	0.9–1.1	1.3–1.5	1.15
Length tarsus I, μ	190	167–183	167–217	250–264	180
Width tarsus I, μ	67–71	76–107	71–107	109–117	75
Ratio length to width, tarsus I	2.67–2.83	2.03–2.83	2.0–2.6	2.3–2.8	2.4
Length tibia I, μ	131–138	119–155	124–171	167–183	130
Width tibia I, μ	64–67	74–107	71–107	107–119	80
Ratio tarsus I to tibia I	1.41–1.49	1.35–1.6	1.21–1.47	1.25–1.5	1.63
Length of palpal claw, μ	32–38	38–48	35–41	43–52	
Ratio of claw to palpal tibia	0.6–0.66	0.52	0.55–0.62	0.53–0.61	
Number of apical setae on tarsus	3–5	9–11	7–8	12–14	
Tibial setae at tarsal base	1	2	2	2	
Length scutum, μ	120–150	144–195	152–190	190–209	
Width between sensillae, μ	38–47	57–69	48–50	69–74	
Length of sensillae, μ	131–143	167–179	155–177	250	
Diameter of eye over distance between sensillae	0.75–1.0	0.3–0.5	0.35–0.5	0.25–0.4	
Length longest humeral setae, μ	31	31–43	30–48	43	25
Length longest posterior setae, μ	36–40	48–76	45–69	110–138	70
Ratio humeral to posterior seta	0.7–0.8	0.54–0.7	0.6–0.8	0.4–0.55	0.4
Branches of sensillae	3	3–5	4–6	3	

KEY TO KNOWN AMERICAN TROMBICULA (EUTROMBICULA) ADULTS

A. Palpal tarsus with 3 to 5 apical nude setae; eyes relatively large 0.75 to 1.0 times breadth of sensillary bases to lateral margins; scutum short (120–150 μ); width between sensillae 38 to 47 μ; inner tibial setae at tarsal articulation, one. . . . . **batatas**
AA. Palpal tarsus with 7 to 14 apical nude setae; eyes smaller, no more than 0.5 times breadth of sensillary bases to lateral margin; scutum longer (144–209 μ); width between sensillae 48 μ or more; inner tibial setae at tarsal articulation, usually two.
B. Palpal tarsus with 12 to 14 apical nude setae; posterior body setae attenuated and long (110–138 μ); tarsus I long (250–264 μ); width between sensillae 69 to 74 μ; sensillae long 250 μ. . . . . **göldii**

BB. Palpal tarsus with 7 to 11 apical nude setae; posterior body setae not attenuated, shorter (36–76 μ); tarsus I shorter (167–190 μ); width between sensillae 48–69 μ; sensillae shorter 131–179 μ.
C. Palpal tarsus with 7 to 8 apical nude setae; width between sensillae 48–51 μ. ..... **alfreddugèsi**
CC. Palpal tarsus with 9 to 11 apical nude setae; width between sensillae 55–70 μ. ..... **splendens**

Trombicula (Eutrombicula) multisetosa (Ewing)

Acariscus multisetosa Ewing, 1943, Proc. Ent. Soc. Wash. 54: 65.

Larva.—Palpal claw with inner prong subapical to outer prong. Palpi with genual setae 1–2 branched, ventral tibial setae 2–4 branched. Scutum as shown in Fig. 2. Sensillae with many closely appressed branches. Dorsal setae 50–54, ventral setae 42–46. Two long nude whiplike setae on tibia III, and three such setae on tarsus III as shown in Fig. 3.

Adult.—Unknown.

This species is relatively rare and is known at the present time only from the United States in Florida and the Florida Keys. It has not been recorded to attack human beings, but unengorged larvae were collected on the author's legs and were removed before they had an opportunity to attach. Series of these larvae were collected in dry grassy habitats by the author on the Florida Keys, and they compare well with the type specimens in the U. S. National Museum. Larvae have been collected, either free living or attached to hosts, only during the winter months from 30 October to 2 January.

STANDARD MEASUREMENTS

	AW	PW	SB	ASB	PSB	AP	AM	AL	PL	S	DS
Florida	83	95	40	21	28	26	41	38	48	52	48
Florida	76	93	38	24	28	28	38	38	48	....	45
Florida	76	91	38	21	31	24	36	35	45	52	41
Florida	79	93	40	24	28	28	37	38	52	52	43
Ave	79	93	39	23	29	26	38	37	48	52	44

DISTRIBUTION

Florida: Christmas, Bonita Springs, Tallahassee, Shell Point.
*Florida Keys: Cudjoe Key.

HOSTS

U. S.	* ? *Homo sapiens*	? Man (not attached)
U. S.	*Procyon lotor*	Raccoon
U. S.	*Sigmodon hispidus littoralis*	Cotton Rat
U. S.	*Sturnella magna argutula*	S. Meadowlark

* New host or locality data.

Trombicula (Eutrombicula) batatas (Linnaeus)

This species is the first described trombiculid mite. The synonymy and numerous references have been compiled by Fuller (1949). The generic and specific names and combinations together with their

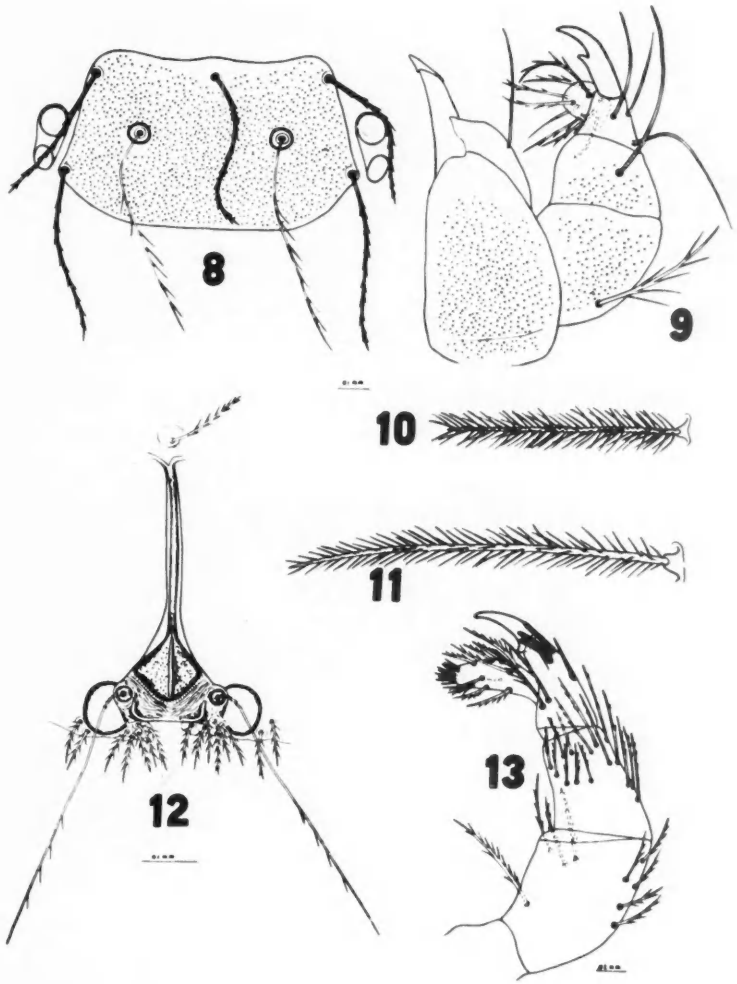


FIG. 8. Scutum of *Trombicula göldii* larva. 9. Dorsal view of right palp of *T. göldii* larva. 10. Posterior body hair of adult *T. splendens*. 11. Posterior body of hair of adult *T. göldii*. 12. Scutum of adult cotype of *T. splendens* showing eyes posterolateral to sensillary bases, sensillae, saddle between sensillary bases, carina and crista. 13. Inner view of palp of adult *T. splendens*. (Figures 8 to 11 are drawn to the same scale as figures 2 to 7, Plate I.)

author and dates are as follows: ***Acarus batatas***, Linnaeus (1758); ***Gamasus batatus***, Fabricius (1805); ? ***Leptus irritans***, Lucas (1847); "***Pattata-luis***," Van Stockum (1904); ***Thrombidium batatas***, Oudemans (1905); ***Leptus batatus***, Brumpt (1913); ***Microthrombidium batatas***, Oudemans (1927); ***Trombicula flui***, van Thiel (1930); ***Trombicula batatas***, Ewing (1931); ***Trombicula hominis***, Ewing (1933); ***Otonyssus batatas***, Oudemans (1937); ***Eutrombicula hominis***, Ewing (1938); ***Eutrombicula flui***, Ewing (1938); ***Trombicula pastorae***, Boshell and Kerr (1942); ***Acariscus flui***, Ewing (1943); ***Acariscus hominis***, Ewing (1943); ***Eutrombicula batatas***, Michener (1946).

In addition to this list the following new synonymy is added.

Trombicula brasiliensis Ewing, 1925, Proc. Ent. Soc., Wash. 27(4): 91–92. Bequaert, 1926, Contr. Harvard Inst. Trop Biol. 4: 152–257. Ewing, 1928, Proc. Ent. Soc. Wash. 30: 77. Stiles and Nolan, 1929, Hyg. Lab. Bull. No. 152, p. 485. André, 1930, Mem. Soc. Zool. 29: 109. Van Thiel, 1930, Parasitology 22: 353. Ewing, 1931, Proc. U. S. Nat. Mus. 80: 7. Ewing, 1933, Proc. U. S. Nat. Mus. 82: 6. Neveu-Lemaire, 1938, Traite d'Ent. etc., p. 492. Torres and Braga, 1939, Bol. Sec. Agr. Indust. 4: 38. Sig. Thor and Willman, 1947, Das Tierreich, 71b: 284–291.

Eutrombicula brasiliensis (Ewing) Ewing, 1938, J. Wash. Acad. Sci. 28: 294. Radford, 1942, Parasitology 34: 66.

Acariscus brasiliensis (Ewing) Ewing, 1943, Proc. Ent. Soc. Wash. 45: 61-62.

Larva.—Palpal claw with inner prong subapical to outer prong. Palpi with genual setae one- to three- branched, ventral tibial setae two- to five-branched. Scutum as shown in Fig. 4. Dorsal setae 32–36, ventral setae 22. Two long nude whip-like setae on tibia III, and three such setae on tarsus III as shown in Fig. 3.

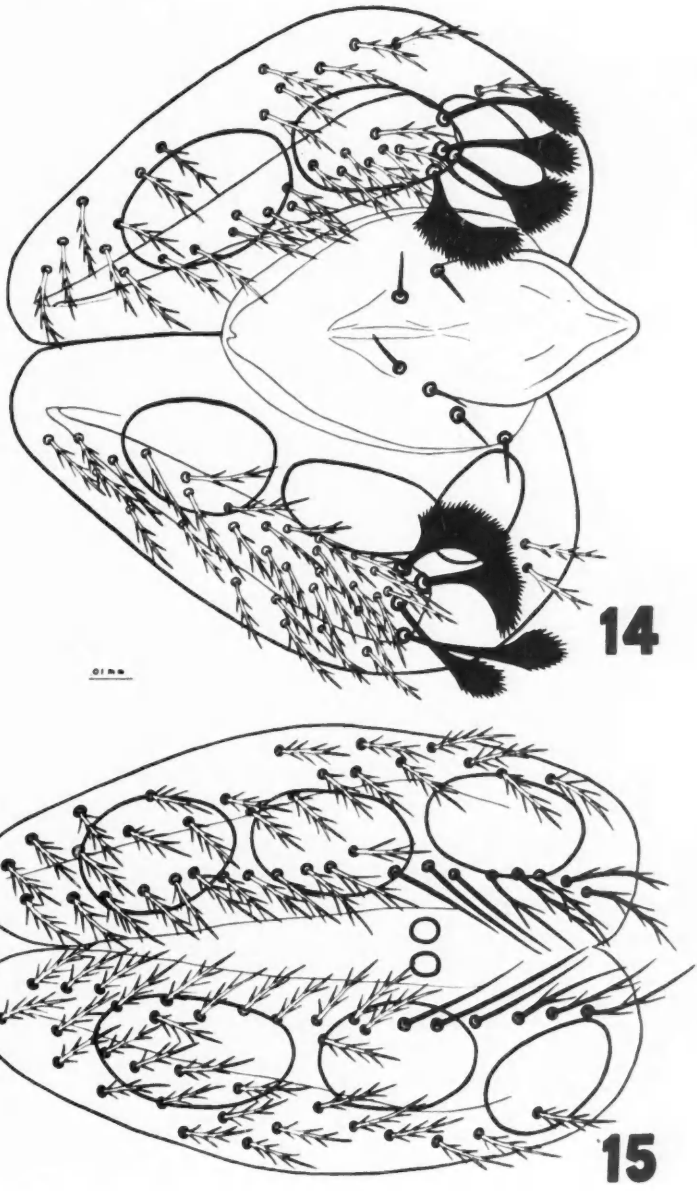
Adult.—Length of adults 0.7 to 1.0 mm. Palpal tarsus with three to five nude apical setae. Inner tibial setae at tarsal articulation, one. Width between sensillae 38–47 μ. Length of sensillae 131–143 μ. Diameter of eye 0.75 to 1.0 times width of sensillary bases to lateral margins. Length of tarsus I about 190 μ. Posterior body setae not attenuate, 36–40 μ in length.

T. batatas is one of the most abundant species of chiggers causing trombidiosis of human beings in tropical America. It is an important pest of human beings and of domesticated animals, especially chickens. The known range of the species extends from Brazil to the United States. It is most abundant in open grassy habitats in small inhabited areas in northern South America and Panama.

The type specimens of *T. batatas* are not known to exist. The use of this name has been discussed and the species fully described by Michener (1946a) and Fuller (1949), and rearing methods were presented by Michener (1946a) and Jenkins (1946, 1947). The present author has compared the type specimens of *T. hominis* Ewing, *T. pastorae* Boshell & Kerr, *T. brasiliensis* Ewing, and topotypic specimens of *T. flui* van Thiel, and finds them to be indistinguishable. *T. brasiliensis* is considered to be a synonym after examination of the three type specimens from Manaos and other specimens from Carvoeiro,

EXPLANATION OF PLATE III

FIG. 14. Ventral view of male genital area of adult *T. splendens*. The four pairs of fan-like genital setae are shown in black. 15. Ventral view of female genital area of adult *T. splendens*.


14
15

Brazil, in the U. S. National Museum. All of these are typical *T. batatas* with 34–36 dorsal setae, except that one type specimen has two dorsal setae broken off from their discernible setal pits. All of these specimens have the characteristic palpal and tarsal setae and standard measurements of *T. batatas*.

T. batatas is slightly variable over its extensive range and a few minor differences have been noted in the number of branches of the palpal genual and ventral tibial setae, in the sclerotization of the scutum, and setal lengths of tarsi III. These differences were not constant and the standard measurements were not significantly different. With more detailed study of large series of specimens, subspecies might be distinguished.

STANDARD MEASUREMENTS

	AW	PW	SB	ASB	PSB	AP	AM	AL	PL	S	DS
Georgia	62	75	23	18	20	21	31	35	41	55	35
Georgia	73	83	38	23	28	26	26	28	41	52	41
Florida	59	59	23	20	23	21	31	28	38	...	31
Panama	59	62	24	21	26	23	28	31	45	52	41
Panama	66	73	28	21	30	24	31	35	48	49	38
Ave	64	71	27	21	25	23	29	31	43	52	37

DISTRIBUTION

BRAZIL
Amazonas: Manaos, Carvoeiro, Vista Alegre (?), Boa Esperanca (?), Parima (?).
Para: Para, Ilha de Marejo.

DUTCH GUIANA
Paramaribo, Kwatta, Duisberg, Mattonshoop, Leiding, l'Hermitage.

FRENCH GUIANA
Cayenne and interior.

VENEZUELA
*Carabobo: Palma Sola.
*Bolivar: Caicara.
*Zulia: Rio Chama.

COLOMBIA
Bolivar: Landazuri.
Meta: Restrepo.

PANAMA
Canal Zone: Juan Mina, Summit.
Panama Province: Panama City, Camaron, Chilibre, Matías Hernández.
Colon Province: Santa Rosa, Gatuncillo.
Aguas Buenas.

MEXICO
Puebla.
*Vera Cruz.
*Chiapas.

PUERTO RICO
Guaynabo, Mayaguez.

*JAMAICA

UNITED STATES
Florida: Immokalee, *Brooksville, *Orlando.
Alabama: Fairhope.
Georgia: Savannah, *Thomasville.
California: Kern Co., Tulare Co. (Furman & Doetschman, in press).

HOSTS

D. Guiana, Fr. Guiana, *Ven., Pan., Mexico, U.S., *Brazil	*Homo sapiens*	Man
Pan., U. S.	*Canis familiaris*	Dog
U. S.	*Odocoileus virginianus*	Deer
Puerto Rico	*Equus caballus*	Horse
Fr. Guiana	*Equus asinus*	Donkey
Pan	*Bos bovis*	Cow
Pan	*Capra hircus*	Goat
Brazil	*Dasyprocta aguti*	Agouti
*Jamaica	**Herpestes griseus*	Mongoose
Pan	*Rattus* sp.	Rat
Pan	*Sylvilagus gabbi*	Forest rabbit
U. S.	*Sylvilagus floridanus*	Cottontail rabbit
U. S.	*Sigmodon hispidus*	Cotton rat
U. S.	*Didelphis virginiana pigra*	Opossum
U. S., Pan.	*Colinus virginianus*	Bob white
*U. S., Pan., Col., Puerto Rico, D. Guiana	*Gallus gallus*	Chicken
Col., Puerto Rico	*Numida meleagris*	Guinea hen
Col., Brazil	*Meleagris gallopavo*	Turkey
Pan	*Florida caerulea*	Little blue heron
Pan	*Aramides cajanea*	Cayenne wood rail
Pan	*Columbigallina talpacoti rufipennis*	Ground dove
Jamaica	*Columbigallina passerina jamaicensis*	Ground dove
Pan	*Crotophaga ani*	Ani
Pan	*Tapera naevia*	Striped cuckoo
U. S.	*Minus p. polyglottos*	Mocking bird
U. S.	*Toxostoma rufum*	Brown thrasher
U. S.	*Sturnella magna*	Meadowlark
U. S.	*Pipilo erythrophthalmus*	Towhee
Fr. Guiana	*Turdus* sp.	Bird
Pan	*Tyrannus melancholicus*	Berlepsch's kingbird
Pan	*Myiochanes cinereus*	Short-legged wood pewee
Pan	*Troglodytes musculus*	Panama house wren
D. Guiana	?	Lizard

Trombicula (Eutrombicula) splendens Ewing

Trombicula splendens Ewing, 1913, Bull. Amer. Mus. Nat. Hist. 32(5): 113–114. Ewing, 1920, Ann. Ent. Soc. Amer. 13: 381. Ewing, 1926, Ent. News 37: 111–113. Vitzthum, 1929, Zeit. f. Parasit. 2(2): 234. Van Thiel, 1930, Parasitology 22: 353 (refers to *T. splendens* Howard, 1918!). Andre, 1930, Mem. Soc. Zool. France 29: 109. Ewing, 1931, Proc. Nat. Mus. 80: 1–19. Ewing, 1933, Proc. U. S. Nat. Mus. 82: 1–6. Ewing, 1937, Proc. Biol. Soc. Wash. 50: 169. Sig Thor and Willman, 1947, Das Tierreich 71b: 344.

Gen.? sp.? "Irritating chigger" Howard, 1918, Seventeenth Rep. State Entom. Minn. 117: 111–144 (figure of *T. splendens* larva). (New synonymy.)

"American chigger" Ewing, 1921 (Not of Riley, 1873), U. S. Dept. Agr. Bull. 986: 1–19 (figure of *T. splendens* larva). (New synonymy.)

Trombiculoides scabrum Jacot, 1938 (nec Say, 1821), Psyche 45: 121–132. New generic name based on incorrect identification. Adults were presumed to be *Trombidium scabrum* Say, 1821.) Ewing, 1946, Proc. Biol. Soc. Wash. 59: 69–72. (Considered to be a synonym of *Sericothrombicum*.) Wharton, 1948, Psyche 55: 139–140. (Identified as closely related to *Eutrombicula alfreddugesi*. (New synonymy.)

Acariscus masoni Ewing, 1943, Proc. Ent. Soc. Wash. 45: 60. Farner, 1946, Proc. Ent. Soc. Wash. 48(2): 32. Farner and Seaman, 1946, Jour. Parasit. 32: 93. Farner, 1947, Proc. Biol. Soc. Wash. 60: 29–30. Jenkins, 1946, CWS Quarterly Prog. Rep. 10: 34–38. (New synonymy.)

Eutrombicula masoni (Ewing) Jenkins, 1947, Ann. Ent. Soc. Amer. 40: 57. Jenkins, 1948, Amer. Jour. Hygiene 48: 22, 36. Wharton, 1948, Psyche 55: 139. (New synonymy.)
Trombicula (*Eutrombicula*) *splendens* Ewing, Jenkins, 1949, J. Parasit. 35: 201.

Larva.—Palpal claw with inner prong subapical to outer prong. Palpi with genual setae unbranched to three- (usually one- to two-) branched, ventral tibial setae three- to four-branched. Scutum as shown in Fig. 1. Dorsal setae 26 (rarely 24), ventral setae 16. Tibia III with no long nude whip-like setae, tarsus III with one such seta.

Adult.—Length 0.9–1.4 mm. Palpal tarsus with nine to eleven simple apical setae. Inner tibial setae at tarsal articulation, usually two. Width between sensillae 57–69 μ. Length of sensillae 167–179 μ. Diameter of eye 0.3–0.5 times width of sensillary bases at lateral margins. Length of tarsus I from 167–183 μ. Posterior body setae not attenuate, 48–76 μ in length.

The larvae of *T. splendens* are the most important cause of human trombidiosis in the southeastern part of the United States, especially in Florida. They are most abundant in swamps, bogs, and moist places along the coastal plain and inland about 150 miles from Texas to Florida and north to Massachusetts. This species is also found through the Great Lakes region and up the Mississippi River valley to Minnesota. Larvae of this species have been used in extensive tests in relation to chigger repellents, miticide impregnation of clothing, and chemical area control of the larvae. The bionomics and behavior are discussed by Jenkins (1948a, b), and a map of the distribution of the species by counties in the United States is presented.

This species was first discovered in the adult stage in 1909 under stones in a tamarack bog in Wisconsin and was named *Trombicula splendens* by Ewing (1913). The larvae were discovered in Minnesota and figures were published by Howard in 1918 and by Ewing in 1921, but they were unidentified and were not correlated with the adults. The larvae were finally described from Florida specimens and named *Acariscus masoni* by Ewing (1943), but the adults were unknown. Topotypic larvae which had been compared with the types of *A. masoni* were reared through several generations by Jenkins (1947). The reared adults were compared with the existing type specimens of *T. splendens* and were found to be the same by Jenkins (1949), and consequently *A. masoni* was dropped as a valid species. The type specimens of *T. splendens* consist of a type adult in poor condition in the U. S. National Museum, and a cotype adult in the American Museum of Natural History which was kindly loaned by Dr. C. D. Michener. These types were remounted in polyvinyl alcohol and the cotype is illustrated in Figs. 11 to 13. In the original description of the adult by Ewing in 1913, the eyes are said to be absent, and in 1920 it is stated by the same author that the sensillae (pseudostigmatic organs) originate between the sensillary bases (pseudostigmata). In the type, cotype, and reared adults, eyes are present and the sensillae originate from the centers of the sensillary bases as shown in Fig. 12.

The larvae are somewhat variable, and as stated previously, a pair of dorsal setae may be absent leaving 24 dorsal setae. In the southern United States, it is not uncommon to find white or slightly pinkish

instead of the usual red larvae. This variation occurs in local populations and is apparently a genetic albino character. This albino type of larvae has also been obtained in rearing colonies. No morphological character has been found to be correlated with it. The larvae are very closely related to *T. wichmanni* (Oud.) of New Guinea and the southwestern Pacific area. *Trombiculoides* Jacot, 1938, is discussed previously under subgenus *Eutrombicula*.

STANDARD MEASUREMENTS

	AW	PW	SB	ASB	PSB	AP	AM	AL	PL	S	DS
Florida	76	86	40	21	35	26	38	20	48	52	47
Florida	77	87	41	21	31	28	38	35	45	52	48
Florida	76	86	41	21	31	28	38	35	52	52	52
Florida	79	97	45	24	28	31	38	35	38	52	52
Florida	79	91	41	21	28	24	38	35	48	48	48
Florida	76	83	41	21	31	24	38	35	48	52	48
Alabama	79	97	47	21	31	28	38	31	57	52	50
Texas	79	93	45	24	35	28	38	38	48	48	48
Texas	79	95	47	22	35	24	35	35	46	52	48
Texas	79	97	47	21	31	28	31	31	45	48	45
Ave	78	91	44	22	32	27	37	34	48	51	49

DISTRIBUTION

UNITED STATES

Minnesota, Wisconsin, Michigan, Massachusetts, Delaware, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, *Tennessee, *Arkansas. Also reported from Kansas and Nebraska.

CANADA

*Ontario: Welland Co.

HOSTS

The known hosts, Jenkins (1948a) include 42 species of mammals, birds, reptiles, and amphibians. Reptiles, especially snakes and turtles, appear to be the most important natural hosts. Human beings are readily attacked and a severe inflammatory reaction is produced by the larvae.

Trombicula (Eutrombicula) alfreddugèsi (Oudemans)

The synonymy and references to *T. alfreddugèsi* are very extensive and the majority of them have been cited in full by Fuller (1949). The various generic and specific names, authors and dates of the names are as follows: *Leptus irritans*, Riley (1873); *Tetranychus tlalsahuate*, Murray (1877); *Tetranychus irritans*, Murray (1877); *Trombidium irritans*, Hamilton (1896); *Trombidium tlalsahuate*, Brumpt (1910); *Microthrombidium alfreddugèsi*, Oudemans (1910); *Microthrombidium tlalzahuatl*, Oudemans (1912); *Trombicula cinnabaris*, Ewing (1921); *Leptus similis*, Hirst (1921); *Trombicula irritans*, Ewing (1925); *Trombicula tlalzahuatl*, Ewing (1923); *Trombicula alfreddugèsi*, Ewing (1938); *Eutrombicula alfreddugèsi*, Ewing (1938); *Leptus rileyi*, Oudemans (1939).

Many emendations of spelling and lapses can also be added to the preceding list. For the validity of the present name and reasons for the above synonymy see Ewing, 1938, Proc. Helm. Soc. Wash. 5: 26–27.

The following new synonymy is presented:

Trombicula irritans var. *uruguayensis* Andre, 1930, Ann. Parasit. Hum. and Comp. 8 (3 & 4): 355–361. Vitzthum, 1931, Kukenthal's Handbuch der Zoologie 3 (9) 127. Floch and Abonnenc, 1941, Inst. Past. Guyane et Terr. de l'Inini. Pub. 20: 1.

Trombicula vanommereni Schierbeek, 1937, Ann. Parasit. Hum. and Comp. 15 (4): 326–329. Neveu-Lemaire, 1938, Traite d'Entomologie, etc., p. 493. Van Thiel and van Ommeren, 1940, Geneesk. Tijdschr. Ned. Ind. 80 (27): 1639. Van Thiel and van Ommeren, 1941, Acta Leidensia, 15–16: 290. Radford, 1942, Parasitology 34 (1): 60 Not of Floch and Abonnenc, 1941, incorrect determination, see *T. goldii*.

Eutrombicula vanommereni (Schierbeek) Michener, 1946, Ann. Ent. Soc. Amer. 39: 413.

Trombicula butantanensis Da Fonseca, 1932, Mem. Inst. Butantan 7: 147–155. Neveu-Lemaire, 1938, Traite d'Entomologie, p. 493. Torres and Braga, 1939, Bol. Sec. Agr. Indust. Com. 4: 38.

Eutrombicula butantanensis (Da Fonseca) Ewing, 1938, Jour. Wash. Acad. Sci. 28: 294. Radford, 1942, Parasitology 34: 66.

Acariscus butantanensis (Da Fonseca) Ewing, 1943, Proc. Ent. Soc. Wash. 45: 63.

Larva.—Palpal claw with inner prong subapical to outer prong. Palpi with genual setae unbranched to three- (usually one- to two-) branched, ventral tibial setae one- to four-branched. Scutum of *alfreddugèsi* type as shown in Fig. 6. Dorsal setae 22, ventral setae 14. Tibia III with no long nude whip-like setae, tarsus III with one such seta.

Adult.—Length 0.9–1.1 mm. Palpal tarsus with seven to eight nude apical setae. Inner tibial setae at tarsal articulation two (rarely one or three). Width between sensillae 48 to 50 μ. Length of sensillae 155–177 μ. Diameter of eye 0.35–0.5 times width of sensillary bases to lateral margins. Length of tarsus I 167–217 μ. Posterior body setae not attenuated, 45–69 μ in length.

T. alfreddugèsi is the most widespread species and the most important cause of human trombidiosis in the American hemisphere. It is locally common in a wide range of habitats from New York and Ontario, Canada to North Dakota and California south through Central America and the West Indies and South America to Brazil, Uruguay, and probably Argentina. The larvae are important pests of human beings and cause a severe inflammatory reaction. This species is the one commonly encountered in blackberry patches and in the usual picnic and recreation areas in North America.

The larvae are quite variable and a number of species and varieties have been described on the basis of minor variations. After collection of large series in the United States, Venezuela and Panama, and examination of all available material from other countries, (about 3000 specimens), the author regards *T. alfreddugèsi* as a species with a wide latitude of natural variation which can be divided into the type form and one recognizable subspecies. A detailed study of the variation of the branching of the palpal setae and sensillae, and of the standard measurements was made to determine the status of closely related species. These data are tabulated in Tables III and IV. The standard measurements of a topotype of *T. vanommereni* were made by the author, and the types of this species and topotypes of *T. alfreddugèsi* were measured in European museums by Fuller (1949). *T. vanommereni* van Thiel was originally described by comparison with the

distantly related *T. batatas*, and it was not compared with *T. alfreddugèsi* from which it differs only in having the palpal genual seta nude. Michener (1946c) regarded this species as distinct and stated that the larvae were constantly different from closely related species. The present author collected specimens from Panama and found the palpal genual setae to be nude, or with one or two branches. In Venezuela, large series of specimens from single collections averaged 60 per cent with the palpal genual and ventral tibial setae nude (*T. a.* subsp. *tropica*), 40 per cent with the tibial setae branched, of which 25 per cent had the genual seta nude, and the remainder with the genual seta with one or more branches. Larval specimens identified as *T. alfreddugèsi* from the United States in Florida, California, Ohio, Illinois, Kansas

TABLE III

VARIATION IN BRANCHING OF PALPAL SETAE AND SENSILLAE OF *T. alfreddugèsi* AND SUBSP. *tropica*

	Coxal	Femoral	Genual	Ventral tibial	Sensillae
Virginia	6	4–6	2–3	3–4	5–8
Kansas	6	2	0	1	...
Ohio	4–5	4–6	0–2	3–4	5
Nebraska	5–6	5–6	0–1	3–4	5
Florida	5–7	4–6	0–1	0–4	6
Texas	6	5–6	1–2	3–4	5
California	6	5	0–1	2–3	5–8
Mexico	6	5–6	0–4	2–4	5
Panama	5	5	0–2	0–3	5–6
Venezuela	5–7	6	0–2	0–6	6
Uruguay	6	6	2	4	...
Brazil	5–7	5	0	4	5

and North Dakota had the palpal genual seta nude or branched in the same collection or locality. Perhaps the most conclusive evidence of the normal variation found in *T. alfreddugèsi* is the study of topotypes of this species from Mexico by Fuller (1949) who states, "the setae on palpal segment III (genual) are variable on two sides of a single specimen, being nude, or bearing a single short cilia proximal to the midpoint. This applies to the topotypic material as well as to specimens from the United States." The present author has also observed this in specimens from sveral countries, and this would eliminate the only known difference between larvae of *vanommereni* and *alfreddugèsi*. The specimens identified as *T. vanommereni* by Floch and Abonnenc (1941) are *T. göldii*. There are no known distribution or host records of *vanommereni* which show any differences from *T. alfreddugèsi*. The adults of *T. vanommereni* reared by Michener (1946c) were compared with adults of *T. alfreddugèsi* and were found to be almost indistinguishable. An adult specimen of *vanommereni* had only one inner palpal tibial seta at the tarsal articulation, while *T. alfreddugèsi* usually has two setae.

Trombicula irritans var. ***uruguayensis*** Andrè (1930) was described by a detailed comparison with the published description of ***Microthrombidium tlalzahuatl*** Oudemans (1912). The description of the variety appears to be the same as *T. alfreddugèsi* except that the palpal setae are slightly more branched in the variety ***uruguayensis***. Fuller (1949) examined cotype specimens of Andre and considers them to be *T. alfreddugèsi* but perhaps representing a composite. The palpal setae of the cotypes were not more branched. The present author examined topotypic specimens from Uruguay and identified them as typical *T. alfreddugèsi*.

Trombicula butantanensis Da Fonseca, 1932, was originally described as having 28 dorsal setae arranged 2 : 8 : 8 : 2 : 4 : 2 : 2 and with 16 ventral setae. At the request of the present author, Dr. Flavio Da

TABLE IV

STANDARD MEASUREMENTS OF *T. alfreddugesi* AND SUBSP. *tropica* (IN MICRONS)

Location	AW	PW	SB	ASB	PSB	AP	AM	AL	PL	S	DS
Virginia	93	100	45	21	31	24	39	38	55	59	45
Ohio	90	91	45	21	31	25	...	31	48	52	39
Missouri	74	87	42	24	28	28	28	29	42	42	35
Texas	69	83	35	21	26	26	35	31	41	48	41
Texas	69	85	41	21	31	24	28	31	41	48	41
Texas	71	86	39	21	26	26	24	31	41	48	41
Florida	75	89	43	24	28	27	30	28	41	47	35
Florida	77	90	43	26	35	28	28	28	39	48	38
Florida	81	86	43	26	35	28	28	28	41	48	35
Florida Keys	76	86	39	25	35	26	28	29	45	48	38
Mexico	76	84	39	28	28	29	43	42	59	...	55
Panama	77	88	43	20	30	26	31	31	41	48	38
Panama	79	86	45	20	31	27	31	31	41	48	41
Panama	90	100	45	24	35	31	41	38	49	59	49
Panama	90	100	45	24	35	28	41	41	52	59	55
Dutch Guiana	80	95	44	24	31	27	31	35	42	49	35
Venezuela	79	86	45	21	31	24	35	35	48	48	45
Venezuela	85	95	45	24	31	24	35	41	45	...	45
Ave	81	90	43	23	31	27	33	33	45	50	42

Fonseca reexamined the holotype and found 20 dorsal setae and 16 ventral setae. He then very kindly loaned the holotype of this species for further study. The single larva is mounted on slide 23 numbered 00028 and labeled "Holotypo-capt. sobra J. B. Arantesa, 12.II.32." The larva was collected from the arm of a man and is fully engorged, with the typical 20 dorsal and 16 ventral setae of engorged larvae. It agrees in every observed detail with *T. alfreddugèsi*, having nude genual and branched ventral tibial palpi as in the named variation *T. vanommereni*. The standard measurements closely approximate the average of *T. alfreddugèsi*. The holotype has been returned to the Instituto Butantan, Sao Paulo, Brazil.

DISTRIBUTION

UNITED STATES: From New York to North Dakota and south to Florida and Texas, also in Arizona and California. For detailed distribution see Jenkins (1948a).

*CANADA
Ontario: Welland Co.

MEXICO
Puebla: Matamoras, Acatlan.
Yucatan: Chichen Itza.
Temascaltepec.

PANAMA
Colon Province: Santa Rosa, Agua Clara, Gatuncillo, Rio Limon.
Panama Province: Rio Limon, Matías Hernández, Las Guacas.
Canal Zone: Gatun Lake, Juan Mina.
Darian Province: El Real.
Parito, Aguas Buenas.

BRAZIL
Sao Paulo: Butantan.
Matto Grosso: Correntes.

VENEZUELA
*Bolivar: Puruey, Caicara.
*Carabobo: Palma Sola.
Zulia: Rio Chama.

DUTCH GUIANA
Paramaribo, Duisburg.

*PERU
Lima.

URUGUAY
Montevideo.

WEST INDIES
Bahama Islands.
Cuba: Cabo Cruz.
Haiti: San Michel.
*Trinidad: Tumpuna.

HOSTS

The natural hosts for this species are mammals, birds, reptiles, and amphibians. A list of 71 known hosts in the United States was presented by Jenkins (1948a). Additional host records from Texas by Melvin et al. (1943) and Brennan (1945) are compiled with other host records from various countries of the American hemisphere.

U. S., Mex., *Ven., D. Guiana, Uruguay, Brazil	*Homo sapiens*	Man
Pan	*Canis familiaris*	Dog
Pan	*Pecari angulatus*	Peccary
Pan	*Odocoileus chiriquensis*	White tailed deer
U. S., Pan	*Capra hircus*	Goat
Pan	*Nasua narica panamensis*	Coati
Pan	*Hydrochoerus isthmius*	Capybara
Pan	*Dasyprocta punctata*	Spotted agouti
Uruguay	*Cavia aperea*	Guinea pig
Pan	*Sylvilagus gabbi*	Forest rabbit
Mex	*Citellus variegatus rupestris*	Mexican rock squirrel
*Can	*Microtus p. pennsylvanicus*	Field mouse.
U. S	*Dasypus novemcinctus texanus*	Armadillo
Pan	*Butorides v. virescens*	Green heron
Uruguay	*Nothura maculosa*	Spotted nothura
Pan., D. Guiana	*Gallus gallus*	Chicken
Cuba	*Mniotilta varia*	Black and white warbler
Pan	*Arremonops conirostris*	Lafresnay's sparrow
U. S	*Crotalus atrox*	Diamond-back rattlesnake

Pan	*Drymarchon corais melanurus*	Gopher snake
Pan	*Spilotes pullatus*	Rat snake
Brazil	*Ophis merremii*	Boipeva snake
U. S	*Thamnophis sauritus proximus*	Western ribbon snake
U. S	*Thamnophis marcianus*	Marcy's garter snake
U. S	*Thamnophis eques*	White-bellied garter snake
U. S	*Masticophis flagellum testaceus*	Coach whip snake
U. S	*Masticophis taeniatus girardi*	Striped racer
U. S	*Elaphe obsoleta confinnis*	Chicken snake
Uruguay	*Teius teyon*	Lizard
U. S	*Cnemidophorus gularis*	Race runner
U. S	*Sceloporus olivaceus*	Large-scaled swift
U. S	*Sceloporus undulatus fasciatus*	Small-scaled swift
U. S	*Phrynosoma cornuta*	Horned toad
Mex	*Ameiva undulata undulata*	Lizard
Pan	*Ameiva praesignis*	Lizard
Ven	*Anadia bitaeniata*	Lizard
Bahamas, Haiti, D. Guiana		Lizard

Trombicula (Eutrombicula) alfreddugèsi subspecies **tropica** (Ewing)

Trombicula irritans var. *tropica* Ewing, 1925, Amer. Jour. Trop. Med. 5: 258. Sambon, 1928, Ann. Trop. Med. and Parasit. 22: 77. Ewing, 1929, Proc. Ent. Soc. Wash. 31: 10. Andre, 1930, Mem. Soc. Zool. France 29: 109. Van Thiel, 1930, Parasitology 22: 353.

Trombicula tropica (Ewing) Ewing, 1931, Proc. U. S. Nat. Mus. 80(8): 10.

Eutrombicula tropica (Ewing) Ewing, 1938, Jour. Wash. Acad. Sci. 28: 294. Radford, 1942, Parasitol. 34: 66. Michener, 1946, Ann. Ent. Soc. Amer. 39: 414.

Trombicula lacertillae Boshell and Kerr, 1942, Rev. Acad. Colomb. Cien. Exact., etc., 5: 12. (New synonymy.)

Trombicula (Eutrombicula) tlalsahuate var. *tropica* (Ewing) Sig Thor & Willman, 1947, Das Tierreich 71b: 276.

Larva.—Similar to *T. alfreddugèsi* except that the palpal genual and ventral tibial setae are always nude.

Adult.—Unknown.

This subspecies appears to have the same habitat and host requirements as *T. alfreddugèsi*, and also causes human trombidiosis. It was originally described as a variety and then changed to a full species. In the original description of var. *tropica*, the "rostral collar" was described as being larger and more conspicuous than in *alfreddugèsi*, and the palpi similar but the femoral palpal setae were said to typically have one long barb near the tip and slightly below it a small short barb, barbs varying from one to four.

Examination of the type specimens in the U. S. National Museum, and series of specimens collected by the author from Venezuela, Panama and Florida show these characters to be without taxonomic significance. The type specimens of *tropica* are distinctive in having the palpal genual and ventral tibial setae without branches. After examining large series of specimens from New England to Nebraska and south to Uruguay, *T. alfreddugèsi* was found to be most abundant in the north and south temperate regions, while typical *tropica* specimens were found only in tropical regions from Florida and California south to Venezuela and Colombia. The *tropica* variation is considered to be a subspecies with a somewhat doubtful status, since it has not been observed to be geographically segregated from *T. alfreddugèsi*. The

subspecies has been collected in grassy areas especially near streams and swamps.

Paratypes of ***Trombicula lacertillae*** Boshell and Kerr from Colombia deposited in the U. S. National Museum, are indistinguishable from the types of subspecies ***tropica***, according to the writer's observations. The standard measurements of ***tropica***, ***lacertillae*** and ***T. alfreddugèsi*** are not significantly different.

DISTRIBUTION

VENEZUELA
Zulia: Chama River.
*Bolivar: Puruey, Caicara.
*Carabobo: Palma Sola.
COLOMBIA
Santander: Cimitarra, Mun. de Bolivar
Meta: Restrepo, Villavicencio.
PANAMA
*Canal Zone.
PUERTO RICO
UNITED STATES
Florida.
*California.

HOSTS

*Ven., *Florida	*Homo sapiens*	Man
Puerto Rico	*Equus caballus*	Horse
Ven	*Anadia bitaeniata*	Lizard
*Pan		Lizard
Colombia		Blue-headed lizard

Trombicula (Eutrombicula) tinami (Oudemans)

Microthrombium tinami Oudemans, 1910, Ent. Ber. 3, 3(54): 84. Oudemans, 1912, Zool. Jb., Suppl. 14 (1): 24–26, 189, 201.
Trombicula tinami (Oudemans) Methlagl, 1928, Dentschr. Akad. Wiss. Wien, 101: 216, 223, 224. Ewing, 1931, Proc. U. S. Nat. Mus. 80 (8): 10. Sig Thor & Willman, 1947, Das Tierreich 71b: 279.
Eutrombicula tinami (Oudemans) Ewing, 1938, J. Wash. Acad. Sci., 28: 294. Radford, 1942, Parasitology 34: 67.
Otonyssus tinami (Oudemans) Buitendijk, 1944, Zool. Meded. 24: 338.

Larva.—Palpal claw with inner prong about one-half as long and located medially to outer prong. Palpi with genual setae four- to five-branched, ventral tibial setae four- to five-branched. Scutum of ***goldii*** type as shown in Fig. 8. Dorsal setae 22, ventral setae 16. Tibia III with no long nude whip-like setae, tarsus III with one such seta.

Adult.—Unknown.

T. tinami appears to be closely related to ***T. göldii***. It has not been reported to attack human beings and nothing is known of its bionomics. Fuller (1949), examined the type material in the Oudemans and Trouessart collections, and the present author borrowed the type. The original description and figures were verified; however, the branching of the palpal genual setae was somewhat less.

DISTRIBUTION

BRAZIL (locality not specified).

HOSTS

Brazil	*Crypturellus noctivagus*	Red-footed tinamou

Trombicula (Eutrombicula) göldii (Oudemans)

Microthrombidium göldii Oudemans, 1910, Ent. Ber. 3(54): 84. Oudemans, 1912, Zool. Jb. Suppl. 14 (1): 13–15, 188, 201.

Trombicula göldii (Oudemans) Bequaert, 1926, Med. Rept. Hamilton Rice Exped., Chap. 14: p. 178. Methlagl, 1928, Denkschr. Akad. Wiss. Wien, 101, pp. 216, 223, 224. André, 1930, Mem. Soc. Zool. Fr. 29(2): 109. Ewing, 1931, Proc. U. S. Nat. Mus. 80: 7. Boshell and Kerr, 1942, Rev. Acad. Colomb. Ciencias 5: 112.

Eutrombicula göldii (Oudemans) Ewing, 1938, J. Wash. Acad. Sci. 28: 294. Radford, 1942, Parasitology 34: 66. Fairchild, 1943, Amer. J. Trop. Med. 23: 587. Ewing, 1944, J. Parasit. 30: 344. Michener, 1946, Ann. Ent. Soc. Amer. 39: pp. 101 and 414.

Otonyssus göldii (Oudemans) Buitendijk, 1945, Zool. Meded. 24: 338.

Microthrombidium helleri Oudemans, 1911, Ent. Ber. 3(57): 120. Oudemans, 1912, Zool. Jb. Suppl. 14(1): 15–18, 188, 201. Oudemans, 1927, Tijdschr. v. Ent. 70: 72. Van Thiel, 1930, Geneesk. Tijdschr. Ned. Ind. 70: 48. (New synonymy.)

Trombicula helleri (Oudemans) Methlagl, 1928, Denkschr. Akad. Wiss. Wien 101: 216, 223, 224. Van Thiel, 1930, Parasitology 22(3): 346. Ewing, 1931, Proc. U. S. Nat. Mus. 80: 8. Schierbeek, 1937, Ann. Parasit. Hum. Comp. 15: 328. Van Thiel and van Ommeren, 1940, Geneesk. Tijdschr. Ned. Ind. 80(27): 1638. (New synonymy.)

Eutrombicula helleri (Oudemans) Ewing, 1938, J. Wash. Acad. Sci. 28(6): 294. Radford, 1942, Parasitology 34(1): 66. Michener, 1946, Ann. Ent. Soc. Amer. 39: 411. (New synonymy.)

Trombicula vanommereni Schierbeek. Floch and Abonnenc, 1941, (not of Schierbeek, 1937), Inst. Pasteur Guyane Pub. 20: 1–22, Pub. 40: 1–5, Pub. 64: 1–4. (New synonymy.)

Eutrombicula defecta Ewing, 1946, J. Parasit. 32: 439. (New synonymy.)

Larva.—Palpal claw with inner prong about one-half as long and located medially to outer prong. Palpi with genual setae nude (rarely one-branched), ventral tibial setae nude as shown in Fig. 9. Scutum shown in Fig. 8. Dorsal setae 22, ventral setae 16. Tibia III with no long nude whip-like setae, tarsus III with one such seta.

Adult.—Length 1.3–1.5 mm. Palpal tarsus with 12 to 14 nude apical setae. Inner tibial setae at tarsal articulation, two. Width between sensillae 69–74 μ. Length of sensillae about 250 μ. Diameter of eye 0.25–0.4 times width of sensillary area. Length of tarsus I from 250 to 264 μ. Posterior body setae long and attenuated 110 to 138 μ.

In tropical America, *T. göldii* is an important pest, and a cause of human trombidiosis. In Venezuela and Panama engorged larvae were removed from the author's skin, where they had produced the typical inflammatory reaction. Human beings have been reported to be attacked in Dutch Guiana, French Guiana, and Colombia. The larvae are found most commonly in the tropical forest, especially second growth jungle areas, where they may be locally abundant.

The larval types of *T. göldii* and *T. helleri* were well described and illustrated by Oudemans (1912). Careful study of the descriptions and illustrations reveal no specific differences between the two forms. Fuller (1949) has studied the types of *T. göldii* in the Trouessart collection and confirmed the original description. Unfortunately it was not possible for him to compare them with the type of *T. helleri* which was originally placed in the Hamburg Museum. Specimens of *T. helleri* larvae and an adult collected by Michener (1946c) and larvae collected by the author in Panama were compared with larvae and adults of *T. göldii* collected by Boshell and Kerr (1942) from Colombia

and they were found to be indistinguishable. From the illustrations and descriptions of larval specimens from French Guiana identified as *T. vanommereni* by Floch and Abonnenc, it is apparent that they are *T. göldii*. This was confirmed by Fuller and the author on specimens from French Guiana sent by Dr. Abonnenc. The two cotype larval specimens of *Eutrombicula defecta* Ewing were studied by the author in the U. S. National Museum, and were found to be faded poorly mounted specimens, one of *T. göldii*, and one *T. alfreddugesi*. In the original description by Ewing, the palpal femoral setae and the sensillae are said to be nude. Under oil immersion it is observed that these setae are normally branched, and that the described small inner prong of the palpal claw is due to the position in which the palpi are mounted. The present author has designated U. S. N. M. type 1429 as lectotype, and *Eutrombicula defecta* Ewing is thus considered to be a synonym of *T. göldii*. The standard measurements of specimens of *T. göldii* from Venezuela, Colombia and Panama are presented in Table V.

TABLE V

STANDARD MEASUREMENTS OF *T. göldii*

	AW	PW	SB	ASB	PSB	AP	AM	AL	PL	S	DS
Venezuela	79	97	48	21	35	31	.....	45	63	.....	63
Panama	81	93	45	21	35	28	41	40	48	59	45
Panama	76	86	39	21	.....	26	41	37	52	55	43
Panama	79	93	43	21	31	30	41	38	48	55	45
Panama	79	90	43	21	31	26	41	38	45	57	45
Panama	79	90	43	21	31	28	45	38	48	55	45
Panama	79	90	41	23	29	28	41	38	48	52	45
Panama	76	88	39	21	28	28	41	36	48	.....	45
Colombia	79	97	48	24	39	35	59	52	59	55	59
Colombia	73	97	41	21	35	31	55	48	59	.....	55
Colombia	62	76	30	18	24	18	41	31	45	.....	45
Colombia	76	90	39	21	35	27	41	38	48	59	48
Ave	77	91	42	21	32	28	44	40	51	56	49

DISTRIBUTION

VENEZUELA
*Carabobo: Palma Sola.
BRAZIL
Para: Para.
DUTCH GUIANA
Paramaribo.
FRENCH GUIANA
Cayenne.
River Compte.
COLOMBIA
Meta: Restrepo, Villavicencio.
Santander: Bolivar.
Boyaca: Muzo.
PANAMA
Panama Province: Panama City, Point Viqué.
Colon Province: Santa Rosa, Gatuncillo.
Herrera Province: Parita.
Canal Zone: Juan Mina, Barro Colorado Island, Irwin Island.

HOSTS

Pan., Col., *Ven., D. Guiana, Fr. Guiana	*Homo sapiens*	Man
Fr. Guiana	*Canis familiaris*	Dog
Col.	*Icticyon venaticus*	
Col.	*Cerdocyon*	
Pan.	*Felis pardalis*	Ocelot
Pan.	*Tapirella bairdii*	Tapir
Pan.	*Mazama sartorii reperticia*	Deer
Col., Brazil, Fr. Guiana	*Dasyprocta aguti*	Agouti
Col.	*Dasyprocta variegata*	Agouti
Pan.	*Dasyprocta punctata*	Agouti
Col.	*Cuniculus paca*	Paca
Pan.	*Rattus* sp.	Rat
Pan.	*Proechimys* sp.	Spiny rat
Col.	*Proechimys chrysaeolus*	Spiny rat
Pan.	*Sylvilagus gabbi*	Forest rabbit
Col.	*Nasua dorsalis*	Coati
Pan.	*Dasypus novemcinctus fenestratus*	Armadillo
Pan.	*Marmosa mexicana isthmica*	Opossum
Col., Pan.	*Didelphis marsupialis*	Opossum
Col.	*Philander laniger*	Opossum
Col.	*Metachirus nudicaudatus colombianus*	Opossum
Pan.	*Gallus gallus*	Chicken
Pan.	*Leptotila verreauxi*	Verreaux's dove
Pan.	*Tyrannidae*	Small flycatcher
Pan.	? *Amevia praesignis*	? Lizard
D. Guiana	? *Passalus*	? Beetle

SPECIES OF UNCERTAIN STATUS

Trombicula (?**Eutrombicula**) **japa** (Ribeyro & Bambarén)

Leptus japa Ribeyro and Bambarén, 1922, Arch. Assoc. Peruana para el Prog. Cien. 2: 115.

Trombicula japa (Ribeyro and Bambarén) Ewing, 1931, Proc. U. S. Nat. Mus. 80(8): 9. Radford, 1942, Parasitology 34: 57.

Larva.—Description incomplete.

Adult.—Unknown.

T. japa causes human trombidiosis in Peru and it is said to be quite abundant in wooded areas in certain parts of the country. The original description and published figures do not permit generic assignment and no type specimens have been available to the author. The inclusion of this species in *Eutrombicula* is doubtful, but typical specimens of *T. alfreddugèsi* have been examined from Peru, and *T. japa* might be a synonym. The authors of this species state that it is very closely related to *Microthrombidium tlalsahuate* of Mexico (syn. of *T. alfreddugèsi*).

A series of about a dozen poor specimens collected from the claw-toed lizard at Verrugas Cañon, Lima, Peru, are in the collection of the U. S. National Museum. These are definitely *Eutrombicula* and are either *T. japa* or a new species related to *T. splendens*. These specimens have about 26 dorsal setae arranged2–6–6–6–2–2 and 16 or 18 ventral setae arranged 2–2–6–2–2–2–(2). The scutum is relatively wide and narrow. Until *T. japa* is definitely identified and described, no new species in this group can be described from the Peruvian area.

DISTRIBUTION

PERU
Valle de Chanchamayo to
Rio Ucayali.

HOSTS

Peru	*Homo sapiens*	Man
Peru		Domesticated animals
Peru		Wild animals

Trombicula (?**Eutrombicula**) **ophidica** Da Fonseca

Trombicula ophidica Da Fonseca, 1932, Mem. Inst. Butantan 7: 151. Sig Thor & Willman, 1947, Das Tierreich 71b: 290.

Eutrombicula ophidica (Da Fonseca) Ewing, 1938, J. Wash. Acad. Sci. 28: 294. Radford, 1942, Parasitology 34: 66.

Larva.—Palpal claw with outer prong slightly subapical to inner prong. Palpi with genual setae two- to four-branched, ventral tibial setae four-branched. Scutum more or less *splendens* type shown in Fig. 1. Dorsal setae 22, ventral setae 20. Tibia III with one simple seta, tarsus III with one nude seta.

Adult.—Unknown.

A larval specimen of the type lot was kindly loaned by Dr. Flavio Da Fonseca. The specimen was not in good condition so that no definite decision could be reached concerning the affinities of the species. The diagnosis was written from the original description supplemented by recent observations.

DISTRIBUTION

BRAZIL
São Paulo: Pronissao, Mattao.

HOSTS

Brazil	*Ophis merremii*	Boipeva snake

Trombicula (?**Eutrombicula**) **lahillei** (Sig Thor & Willman)

Microtrombidium brumpti Lahille, 1927, Bol. Inst. Clin. Quir. B. Aires, 3: 773. André, 1930, Ann. Parasit. Hum. Comp. 8(3, 4): 355. (States type accidentally destroyed.)

Trombicula brumpti (Lahille) van Thiel, 1930, Parasitology 22: 353. Floch and Abonnenc, 1941, Inst. Pasteur Guyane et Terr. de l'Inini 20: 1. Radford, 1942, Parasitology 34: 58.

Microtrombidium lahillei Sig. Thor & Willman, 1947, Das Tierreich, 71b: 292. (*M. brumpti* Hirst, 1915, a synonym of *T. akamushi* preoccupies *M. brumpti* Lahille, 1927, so *M. lahillei* nomen novem was proposed.)

Larva.—Description incomplete.

Adult.—Unknown.

The status of the *Eutrombicula* in Argentina is not understood. *T. lahillei* and *Tetranychus molestissimus* Weyenbergh, 1876 (nomen nudum) are larvae known as "bicho colorado" which cause human trombidiosis. It is possible that they are the larval stage of *Trombicula coarctata*. They are very similar to *T. alfreddugèsi* and may be synonyms.

The original description of this species suggests a very distinctive mite having a setal formula of 4–8–2–6–6, including four humeral setae. Close examination of the published figures shows the type specimens to be fully engorged and with the typical setal formula of 2–6–6–4–2–2 of *T. alfreddugèsi*. The extra pair of small humeral setae are in the posi-

tion of and very likely represent the ventral coxal setae in a cleared specimen. The relationship of this species to *T. alfreddugèsi* could not be determined since the types are destroyed. *T. lahillei* is included in the subgenus *Eutrombicula* since the palpal claws are bifurcate with a smaller inner prong.

DISTRIBUTION

ARGENTINA
Villa Ballaster.

HOSTS

Argentina.....*Homo sapiens*.....Man

Trombicula (?**Eutrombicula**) **coarctata** (Berlese)

Trombidium coarctatum Berlese, 1888, Bull. Soc. Ent. Italiana Ann. 20: 9, 179. Berlese & Leonardi, 1901, Zool. Anz. 659: 17.

Trombicula coarctata (Berlese) Berlese, 1912, Redia 8: 91. Kitashima and Miyajima, 1918, (not of Berlese) Kitasato Arch. Exp. Med. 2: (2, 3). Ewing, 1920, (not of Berlese) Ann. Ent. Soc.Amer. 13: 382–384. Ewing, 1931, Proc. U. S. Nat. Mus. 80: 7. Ewing, 1933, Proc. U. S. Nat. Mus. 82: 2. Ewing, 1937, Proc. Biol. Soc. Wash. 50: 169. Ewing, 1938, J. Wash. Acad. Sci. 28: 292. Sig Thor & Willman, 1947, Das Tierreich 71b: 344.

Larva.—Unknown.

Adult.—Description incomplete.

The adults of this species were the first trombiculid adults seen by Berlese who founded the genus *Trombicula*. No specimens have been available for comparison with *T. alfreddugèsi* which this species appears to resemble closely. If these species are found to be the same, the name of our most common North American chigger would have to be changed again. *T. coarctata* is placed in the subgenus *Eutrombicula* because the eyes are located postero-laterad to the sensillary area, and because the body size, leg, and other measurements are similar.

DISTRIBUTION

ARGENTINA
Buenos Aires.
S. Pedro Missiones.
PARAGUAY
Rio Apa (type locality).
CHILE
Temuco.

HOSTS

Unknown.

Trombicula (?**Eutrombicula**) **manriquei** Ewing

Trombicula manriquei Ewing, 1937, Proc. Biol. Soc. Wash. 50: 169. Boshell and Kerr, 1942, Rev. Acad. Colomb. Cien. Exact., etc., 5: 9.

Larva.—Unknown.

Adult.—Description incomplete, type specimen not in good condition.

The single adult type specimen in the U. S. National Museum was collected from humus in a tree hole in Colombia. The original description states that no eyes are present and that posterior lobes are absent in the pseudostigmatic area. Examination of the type reveals a definite pair of eyes located postero-laterad to the sensillary bases and dorsal posterior lobes are present on the saddle as shown in Fig. 12. The sensillary bases are 44 μ in width and the longest posterior body

hairs are 73 μ in length. The nude apical setae on the tarsi cannot be counted, and other diagnostic characters cannot be distinguished so that identification cannot be made with certainty. It is most closely related to *T. alfreddugèsi* and may be a synonym, but more specimens and rearing of larvae are necessary before this can be established.

DISTRIBUTION

COLOMBIA
Meta: Villavicencio.

HOSTS

Unknown.

Acknowledgments

This study was carried on at the Medical Division, Army Chemical Center, Maryland, and at the Rocky Mountain Laboratory, U. S. Public Health Service, Hamilton, Montana. The author takes pleasure in acknowledging the assistance and suggestions of Drs. E. W. Baker, J. M. Brennan, L. E. Chadwick, H. S. Fuller, C. H. Kennedy, G. M. Kohls, C. B. Philip, and G. W. Wharton. The illustrations were drawn by Miss Alma D. Dinehart, U. S. Public Health Service, Hamilton, Montana, and by the author. Collections of mites were made while on duty in Panama in the U. S. Army, and in Venezuela while a member of an FAO United Nations Mission.

LITERATURE CITED

Berlese, A. 1905. Acari nuovi. Manipulus IV. (Acari di Giava). Redia 2: 154–176.

Brennan, J. M. 1945. Field investigations pertinent to Bullis fever. Texas Rept. Biol. and Med. 3: 112–121.

1947. New species of chiggers (Acarina, Trombiculidae) from bats of the Nearctic region. J. Parasit. 33: 245–252.

Ewing, H. E. 1937. New species of mites of the subfamily Trombiculinae, with a key to the New World larvae of the *akamushi* group of the genus *Trombicula*. Proc. Biol. Soc. Wash. 50: 167–174.

1938. A key to the genera of chiggers (mite larvae of the subfamily Trombiculinae) with descriptions of new genera and species. J. Wash. Acad. Sci. 28: 288–295.

1943. The American chiggers (larvae of the Trombiculinae) of the genus *Acariscus*, new genus. Proc. Ent. Soc. Wash. 45: 57–66.

1946a. Taxonomic notes on American chiggers (larvae of the mite family Trombiculidae, including the redescription of a genus and the descriptions of two new species.) Proc. Biol. Soc. Wash. 59: 21–28.

1946b. Notes on Trombiculid mites with descriptions of Walchiinae n. subf., *Speotrombicula* n. g., and *Eutrombicula defecta* n. sp. J. Parasit. 32: 435–440.

Floch, H., and **E. Abonnenc.** 1941. Trombidides de la Guyane Francaise. Inst. Pasteur de la Guyane et du Terr. del'Inini. Pub. 20: 1–22.

Fuller, H. S. 1949. The mite larvae of the family Trombiculidae in the Oudemans Collection: Taxonomy and medical importance. Zool. Meded., Leiden. (In press.)

Jenkins, D. W. 1946. The experimental rearing of chiggers under laboratory conditions. C. W. S. Quarterly Prog. Rep. 10: 34–38.

1947. A laboratory method of rearing chiggers affecting man. (Acarina, Trombiculidae) Ann. Ent. Soc. Amer. 40: 56–68.

1948a. Trombiculid mites affecting man. I. Bionomics in relation to epidemiology in the United States. Amer. Jour. Hyg. 48: 22–35.

1948b. Trombiculid mites affecting man. II. Control of larval behavior for disease transmission studies. Amer. Jour. Hyg. 48: 36–44.

1949. Trombiculid mites affecting man. III. *Trombicula* (*Eutrombicula*) *splendens* Ewing in North America. J. Parasit. 35: 201–204.

Melvin, R., C. L. Smith, and **O. H. Graham.** 1943. Some observations on chiggers. J. Econ. Ent. 36: 940.

Michener, C. D. 1946a. Observations on the habits and life history of a chigger mite, *Eutrombicula batatas*. (Acarina: Trombiculinae). Ann. Ent. Soc. Amer. 39: 101–118.

1946b. The taxonomy and bionomics of a new subgenus of chigger mites (Acarina, Trombiculinae). Ann. Ent. Soc. Amer. 39: 431–445.

1946c. Taxonomic and bionomic notes on some Panamanian chiggers (Acarina, Trombiculinae). Ann. Ent. Soc. Amer. 39: 411–417.

Wharton, G. W. 1945a. *Trombicula frittsi*, n. sp. (Acarinida: Trombiculidae). J. Parasit. 31: 282–283.

1945b. Two new species of Acariscus: *A. pluvius* and *A. anous* (Acarinida: Trombiculidae). J. Parasit. 31: 401–405.

1948. The generic name *Trombiculoides* Jacot, 1938. Psyche 55: 139–140.

Willman, C. 1941. *Trombicula minor* Berlese 1905, Typenart der Gattung *Trombicula* Berlese. Zool. Anz. 133: 131–136.

Womersley, H. 1944. Notes on and additions to the Trombiculinae and Leeuwenhoekiinae (Acarina) of Australia and New Guinea. Trans. Royal, Soc. S. Australia. 68: 82–112.

Womersley, H., and **G. Kohls.** 1947. New genera and species of Trombiculidae from the Pacific Islands. Trans. Roy. Soc. S. Australia. 71: 3–12.

ATLAS DE LOS ANOFELINOS SUDAMERICANOS, by ROBERTO LEVI CASTILLO. 207 pages, 354 figures. Sociedad Filantrópica del Guayas, Guayaquil, Ecuador. Price, $10.00.

This is not an atlas in the same sense as Ross and Roberts' atlases of the mosquitoes or Ferris' atlas of the scale insects. It is an attempt to facilitate identification of the South American anophelines, with an avoidance, so far as possible, of the more difficult technical characters, so that a relatively inexperienced worker may be able to distinguish the malaria-transmitting species from one another and from those that are of little or no importance in this respect.

The work includes a discussion of the zoogeographical distribution of the South American species (pp. 7–19), a section on bionomics (pp. 20–25), a tabulation of the larval breeding places and adult habitats of the various species (pp. 26–31), and of the distribution of the malaria-transmitting species (pp. 32–33), and a reproduction of the more important parts of Gabaldon's (1945) biostatistical methods (pp. 34–50). The body of the work (pp. 51–160) consists of a description of the eggs, larvae, pupae, and adults of the genera (*Chagasia* and *Anopheles*) and of the subgenera of *Anopheles*, together with the keys to the genera, subgenera, and species, and the illustrations. This is followed by a bibliography covering the South American forms (pp. 161–206).

The keys are puzzling to the reviewer, in spite of twenty years' experience in the constant use of keys; it is hard to imagine, therefore, how they might be very useful to the inexperienced worker. The illustrations will help to atone for this deficiency, and the wealth of them is commendable. However, in some cases too great reduction has caused loss of detail or obscuring of the reference symbols; furthermore, some illustrations are too sparingly labelled or explained. Though the illustrations are on a good grade plate paper, the rest of the work is printed on a pulp paper of doubtful durability.

The sale of this work will undoubtedly suffer because of its price. It is useful, however, to have this information under one cover, and the Latin American malariologist will profit by having a manual for anopheline identification written in Spanish.—M. T. J.

METEORUS ARGYROTAENIAE, A NEW SPECIES OF BRACONIDAE PARASITIC ON THE ORANGE TORTRIX[1]

CARL JOHANSEN,
State College of Washington, Pullman

In the course of investigations of the orange tortrix, *Argyrotaenia citrana* (Fern.) on red raspberry at Puyallup, Washington, in 1948, a new species of the braconid genus *Meteorus* was found. This species was first noticed in the raspberry fields about the middle of April, the pupae of the parasite occurring in the tied-leaf nests of the orange tortrix caterpillars. The degree of parasitism had increased to 15–50% in some fields by the last week in July and showed evidence of giving partial control of the orange tortrix in certain fields during the picking season.

The same species was also found in the nests of an undetermined leaf-roller on plane tree at Vancouver, B. C., June 16, 1948.

Meteorus argyrotaeniae n. sp.

Female.—Length 4.2–4.6 mm. Face punctate, opaque. Ocelli moderate, 0.11 mm. in diameter, ocellar-ocular line about one and one-third times diameter of median ocellus; vertex smooth and polished; temples polished. First flagellar segment of antenna about as long as scape and pedicel together; antennae 30- to 35-segmented, about as long as the body. Mesoscutum finely rugulose medially behind median lobe, lobes practically smooth and shining and well set off with sharp notaulices; propodeum rugose with irregular carinae and a channeled posterior face, dorsal face usually with large smooth areas; lateral face of pronotum smooth and shining with only a few short rugae medially; mesopleuron smooth with a crenulate furrow; metapleuron finely, confluently punctate. Wings with stigma large, nearly triangular; first abscissa of radius much shorter than second, third abscissa of radius going nearly to extreme apex of wing, second abscissa of radius shorter than second intercubitus, recurrent vein entering first cubital cell near first intercubitus, lower abscissa of basella subequal to, or slightly shorter than nervellus, radial cell large, extending nearly to apex of wing, radiellan cell narrowing towards the apex with no indication of a cross-vein. Posterior coxa longer than the respective trochanter, sparsely rugulose and shining; posterior femora sparsely rugulose; inner spur of the hind tibia one-third as long as the basitarsus. First abdominal tergite striate with two large dorsal fossae on petiole, the ventral margins of the tergite widely separated; remainder of adbomen smooth and polished; ovipositor sheath 1.7 mm. in length, nearly as long as the abdomen.

Brown or brownish yellow; scape of antenna pale brown, the rest darker; mandibles testaceous with darker tips; head testaceous, often

[1]Published as Scientific Paper No. 836. Agricultural Experiment Stations, Institute of Agricultural Sciences, State College of Washington, Pullman.

varied with brown or black; compound eyes black; prothorax testaceous, darker dorsally; mesothorax and metathorax pale brown, becoming almost black dorsally; wings hyaline, stigma pale; legs entirely pale brown and testaceous; first abdominal tergite black above; rest of abdomen testaceous, darker beneath and at posterior tip, opaque stramineous above; ovipositor pale brown. The cocoon is very thin and milky white in color.

Types.—Holotype, female, July 14 (emerged July 25), 1948, U. S. N. M. No. 59163; Paratopotypes, 14 females; Paratypes, 4 females.

Type locality.—Puyallup, Washington.

Host.—*Argyrotaenia citrana* (Fern.).

Described from 19 female specimens collected by the author at Puyallup, Washington, July 7, 14, 26, and 28 and August 6, 1948, as cocoons (emerged July 25, 28, 29, 30, August 2, 3, 12, 24, 1948); and at Vancouver, B. C., June 16 in host larvae and as cocoons (emerged July 1, 3, 5, 6, 1948).

This species will work out to couplet 8 in Muesebeck's key (Proc. U. S. Nat. Mus. 63(2): 1–44 (1924). It agrees in this couplet most nearly with *Meteorus communis* Cresson; however, the venter of the petiole at its base is rather coarsely roughened in *M. communis*, but only finely rugoso-punctate in *M. argyrotaeniae*, and the ovipositor sheath of *M. communis* is about half as long as the abdomen, as compared with more than three quarters of the length of the abdomen in *M. argyrotaeniae*.

This species is similar to *M. trachynotus* Viereck; however, the stigma of *M. trachynotus* is brown, pale at the base, that of *M. argyrotaeniae* is pale throughout or with darker margins; the first abscissa of radius in *M. trachynotus* is nearly or quite as long as the second whereas in *M. argyrotaeniae* it is much shorter than the second; and usually the propodeum is more closely and more coarsely rugose in *M. trachynotus*.

I wish to thank Mr. C. F. W. Muesebeck for criticism and suggestions and Dr. M. T. James for critical reading of this manuscript.

INSECT DRUMMERS, A STUDY ON THE MORPHOLOGY AND FUNCTION OF THE SOUND-PRODUCING ORGAN OF SWEDISH AUCHENORRHYNCHA, by FREJ OSSIANNILSSON. Opuscula Ent., Supplementum X, 146 pages, 13 plates, 1 text figure. 1949.

The sound-producing organ of the cicadas is well-known, but there has previously been but little information available concerning the poorly-known comparable mechanism of the other Auchenorrhyncha. Unlike that of the cicadas, this is a stridulatory organ. On the basis of the study of 79 Swedish species, representing 15 of the 21 families recognized by him, the author concludes that, since the males of all of these possess an organ homologous in its essential parts with the tymbal mechanism of the Cicadidae, the possession of such an apparatus is general among the Auchenorrhyncha.

The author worked with live insects as well as with preserved specimens. After the more usual morphological descriptions (pp. 15–53), he devotes a chapter to the description of the calls (pp. 54–99), which he attempts to imitate orthographically and with designation of pitch, as well as by radiographic presentation (plates 12–13). His techniques are fully described.

This appears to be a scholarly study of a little-known phenomenon.—M. T. J.

A REVISION OF THE GENERA AND OF THE AMERICAN SPECIES OF TRYPHONINI

(Hymenoptera: Ichneumonidae)

PART I

HENRY K. TOWNES AND MARJORIE C. TOWNES,
State College, Raleigh, North Carolina

This revision includes the species of the tribe Tryphonini occurring in the Western Hemisphere. Most of the tribe is in the temperate and cold regions of the northern hemisphere, and in America, only six species are known from south of the United States. All of the genera and subgenera at present recognized occur in America except the subgenus *Tryphon*, which in this paper is keyed out and discussed to make the scope of the generic treatment worldwide.

This paper is based largely on the Townes collection, greatly supplemented by loans from the U. S. National Museum, the Canadian National Collection, Cornell University, and other collections. The Swedish National Museum and the British Museum lent critical genotypes and other species. The complete list of American collections studied is as follows:

Townes Collection, Raleigh, North Carolina.
U. S. National Museum, Washington, District of Columbia.
Canadian National Collection, Ottawa, Ontario.
Cornell University, Ithaca, New York.
Academy of Natural Sciences, Philadelphia, Pennsylvania.
University of Alberta, Edmonton, Alberta.
California Academy of Sciences, San Francisco, California.
University of Minnesota, St. Paul, Minnesota.
Ohio State University, Columbus, Ohio.
Harvard University (M. C. Z.), Cambridge, Massachusetts.
Oregon State College, Corvallis, Oregon.
Illinois Natural History Survey, Urbana, Illinois.
University of Kansas, Lawrence, Kansas.
University of California, Berkeley, California.
Collection of R. R. Dreisbach, Midland, Michigan.
Collection of R. M. and G. E. Bohart, Davis, California.
Collection of R. T. Mitchell, Bowie, Maryland.
Collection of H. H. Swift, New York City, New York.

In the lists of specimens studied, institutional collections are referred to by the city in which each is located (*i.e.*,Philadelphia for the Academy of Natural Sciences of Philadelphia, Berkeley for the University of California, etc.). These designations are used because they seem more generally intelligible than such abbreviations as I. N. H. S. and

A. N. S. P., and because the city in which a public collection is located is less likely to change than is the name of the institution housing it. Private collections are referred to by the name of the owner. In cases where the authors' collection contains a number of paratypes, some of these will be distributed to other collections.

We are indebted to the Division of Insect Identification of the U. S. Bureau of Entomology and Plant Quarantine and to the U. S. National Museum for the use of bibliographic and library facilities. Many collectors have contributed valuable material for this study. Among them are J. G. Rempel, E. H. Strickland, R. R. Dreisbach, C. E. Michener, H. R. Foxlee, R. M. Bohart, and G. E. Bohart. To these and others we wish to express our thanks.

The tribe Tryphonini is a moderately distinct group, for the Ichneumonidae, but it and the subfamily to which it belongs are difficult to define. Since the authors do not follow the conventional definitions of either group it is, however, necessary to make some statement of the limits used and of some of the supporting characters, although the definition of the subfamily can not at present be made both adequate and practical. To compensate partially for the difficulty of defining the Tryphonini, habitus figures of five of the genera are given (figs. 1, 12, 32, 42, and 43). With these and the characters discussed below, the student should be able to recognize members of the tribe.

Subfamily **Tryphoninae**

As stated above, present knowledge does not permit a clean definition of the subfamily Tryphoninae, nearly every distinctive adult character being subject to exceptions. The Tryphoninae is one of a group of subfamilies that is normally ectoparasitic; whose larvae, as far as known, have the inner end of the maxillary sclerome adjacent to the labial sclerome near or below its middle rather than near its top, and whose adults have the ovipositor without a subapical dorsal notch and usually with an apical series of oblique ridges or teeth. Sometimes when the ovipositor has a subapical elevation, the summit of the elevation may have a weak notch. When the apical part of the ovipositor is unusually slender, these group characters are often obliterated. Another adult character of some value in a definition of these subfamilies is the usual absence of a small tooth on the outer side of the apical rim of the front tibia.

The Tryphoninae differ from other subfamilies of the ectoparasitic series in having the egg with a stalk by which it is attached to the skin of the host (figs. 1, 4, 5, 34, and 35). Some of the Tryphoninae of the tribe Cteniscini have the stalk lost or modified, and by them the entire egg is imbedded in the host's skin. Distinctive characters of adults of the Tryphoninae are: areolet, when present, nearly always oblique, with the first intercubitus shorter than the second; male antenna without tyloids; first tergite usually with glymmae and nearly always with the spiracles before the middle; and tarsal claws usually more or less distinctly pectinate and never with a large basal or subapical tooth. Below is a key to the tribes of the subfamily, and following this a list of the known genera of each.

ARTIFICIAL KEY TO THE TRIBES OF TRYPHONINAE

1. Hind tibia with one spur or none 2
   Hind tibia with two spurs 3
2. Hind tibia with a spur that is longer than the apical diameter of the tibia; middle tibia with two spurs; spiracle of first tergite near its apical 0.4; clypeus with a blunt median point ..... **Sphinctini**
   Hind tibia without a spur; middle tibia with one spur; spiracle of first tergite at or in front of its middle ..... **Cteniscini**
3. Prepectal and occipital carinae absent; propodeum without carinae; apical margin of clypeus with a median pair of blunt teeth; wings blackish ..... **Boëthini**
   Prepectal carina, or occipital carina, or both present 4
4. The part of the first tergite in front of its spiracle at least 1.6 as long as it is wide at its narrowest point; first tergite without a lateral basal corner projecting above the glymma; second recurrent vein with two bullae; propodeum with at least the petiolar area defined by carinae; areolet absent except in some species of *Eclytus* ..... **Eclytini**
   Without the above combination of characters 5
5. First tergite without a glymma (a lateral groove between the spiracle and the base of the tergite) and solidly fused to the first sternite; fore wing 2.5 to 4.5 mm. long 6
   First tergite with a glymma and more or less free from the first sternite; fore wing 2.5 to about 25 mm. long 7
6. Labrum projecting conspicuously beyond the truncate apex of the clypeus as a transverse plate, never hidden by the mandibles ..... **Adelognathini**
   Labrum not or hardly visible, concealed by the clypeus and mandibles, **Phrudini**
7. Propodeum without carinae, or with a single transverse carina that is usually interrupted into two lateral crests; when with a transverse carina or lateral crests, the propodeum is always transversely striate basad of these; spur of front of tibia with its distal portion straight or slightly outcurved, its antennal brush ending considerably before the apex of the spur ..... **Phytodietini**
   Propodeum with carinae, usually with longitudinal as well as one or more transverse carinae, never transversely striate; spur of front tibia evenly curved, its antennal brush extending nearly to its apex 8
8. Labrum projecting conspicuously beyond the apical margin of the clypeus, which is thin and not turned under; areola separated from the basal area, elongate pentagonal, its base reduced almost to a point ..... **Stilbopini**
   Labrum not visible, concealed beneath the clypeus, which has its true apical edge turned under to leave a subapical part as the apparent apical margin; areola not separated from the basal area except in the Patagonian genus *Scolomus* 9
9. Areolet sessile above or sometimes subpetiolate, with the recurrent vein received much nearer to the second intercubitus than to the first; occipital carina going directly to the base of the mandible or joining the hypostomal carina almost at the mandible; fore wing about 2.5 to 4.2 mm. long ..... **Grypocentrini**
   Areolet petiolate, subpetiolate, or absent, or if sessile (in *Scolomus*) then the recurrent vein received about midway between the two intercubital veins; occipital carina joining the hypostomal carina, or sometimes incomplete below, when complete the juncture distant from the mandible by at least 0.2 the basal width of the mandible; fore wing 3.5 to 9 mm. long ..... **Tryphonini**

STILBOPINI. *Stilbops* is the only genus. *Aphanoroptrum* is hereby synonimized with *Stilbops* and its only species, *Pimpla abdominalis* Gravenhorst 1829, referred to *Stilbops* (new combination). The tribe is placed in the Tryphoninae provisionally.

ADELOGNATHINI. The genera included are *Adelognathus*, *Pammicra*, and *Cnemischys*.

PHRUDINI. *Phrudus* is the only genus. The tribe is placed in the Tryphoninae provisionally.

SPHINCTINI. *Sphinctus* is the only genus.

PHYTODIETINI. This tribe includes *Phytodietus*, *Weisia*, and *Netelia*. *Weisia* is known to the authors only by descriptions.

ECLYTINI. This tribe includes *Eclytus*, *Atopotrophos*, *Neliopisthus*, *Campothreptus*, *Hybophanes*, *Thymaris*, and an undescribed Nearctic genus. In 1945 the authors[1] included the then monobasic *Chiloplatys* also, but knowledge of a second species of the genus indicates that *Chiloplatys* is better placed in the Tryphonini.

GRYPOCENTRINI. This tribe includes *Grypocentrus*, *Idiogramma*, and an undescribed Nearctic genus.

BOETHINI. *Boëthus* is the only genus.

TRYPHONINI. This tribe includes *Polyblastus*, *Ctenochira*, *Erromenus*, *Monoblastus*, *Thibetoides*, *Chiloplatys*, *Dyspetus*, *Scolomus*, *Cosmoconus*, and *Tryphon*. The genera are treated taxonomically in this paper.

CTENISCINI. The cteniscine genera recognized at present are *Exenterus*, *Acrotomus*, *Cteniscus*, *Eridolius*, *Diaborus*, *Smicroplectrus*, *Exyston*, *Tricamptus*, *Picroscopus*, and *Anisoctenion*. The tribe is very close to the *Polyblastus* group of the Tryphonini, as *Cteniscus* is hardly distinguishable from *Polyblastus* except on tibial spur and ovipositor characters. The tribal name "Cteniscini" is preferred to "Exenterini" because the former name is based on that of the oldest included genus.

Tribe **Tryphonini**

Members of this tribe are typically stout-bodied species with the propodeum usually rather completely areolated, and the first tergite usually broad and with a pair of median dorsal carinae. The ovipositor is usually short. The key to the tribes and the habitus figures of representative genera (figs. 1, 12, 32, 42, and 43) will assist in recognizing members of the tribe. As far as known all species are parasites of *Tenthredinidae*, the stalked egg being attached to the larva but the parasite's development delayed until after the host spins its cocoon.

Previous taxonomic history in America comprises the proposal of new specific and an occasional new generic name by Cresson in 1864, 1868, 1874, and 1878; by Provancher in 1874, 1875, 1879, 1883, and 1886; by Cameron in 1886; by Ashmead in 1890, 1901, and 1902; by Fyles in 1893; by Davis in 1897 and 1898; by Brues in 1907 and 1919; by Hall in 1919; by Viereck in 1924; and by Townes and Townes in 1945. In 1897–98, Davis included a revision of the Nearctic species of the tribe in his treatment of the Nearctic Tryphoninae (Trans. Amer. Ent. Soc. 24:193–347). Other literature on the tribe includes distributional records, mostly included in regional lists of insects, and host records for four of the species. In 1944 Townes (Mem. Amer. Ent. Soc. 11:147–158) catalogued all of the literature on the Nearctic species and proposed new synonymy and generic placements. Persons interested in a complete record of the literature are referred to this catalogue.

[1]Townes and Townes, 1945. Bol. Ent. Venez., 4: 41–52.

In the present paper, only the references to original descriptions are included for Nearctic species, but the scant literature on the Neotropic species is given complete.

Except for *Tryphon montezuma* Cameron, the types of all specific names proposed for American species were studied in 1941 and some of them again at later dates. Mr. J. F. Perkins of the British Museum has obligingly compared specimens with the types of *Tryphon montezuma*. All genotype species but those of *Trichocalymma*, *Ctenochira*, *Ctenacme*, *Ctenacmus*, *Monoblastus*, and *Nemioblastus* have been seen. These names have been placed after study of the literature with the application of *Trichocalymma* remaining somewhat questionable[2].

A number of American species have been erroneously referred to this tribe. The Nearctic species among them have been placed elsewhere in the previously mentioned catalogue. A few described from Mexico by Cresson have been placed elsewhere in another recent paper (Townes, 1946. Bol. Ent. Venez. 5:29–63). Other species, presumably all misplaced, are as follows:

Polyblastus? aztecus Cameron, 1886. Biol. Centr.-Amer., Hymen. 1:287. Type: ♂, Northern Sonora, Mexico (type lost).

Tryphon cerberus Dewitz, 1881. Berlin. ent. Ztschr. 25:207. Type: ♂, Puerto Rico (Berlin).

Tryphon cinctus Cresson, 1865. Proc. Ent. Soc. Philadelphia 4:16. Type: ♂, Cuba (Havana).

Tryphon? claviventris Cresson, 1865. Proc. Ent. Soc. Philadelphia 4:17. Type: ♂, Cuba (Havana).

Tryphon? exiguus Cresson, 1865. Proc. Ent. Soc. Philadelphia 4:16. Type: ♀, Cuba (Havana).

Tryphon lineolatus Brullé, 1846. Hist. Nat. Insectes Hymén. 4:318. Type: ♀, Prov. des Mines, Brazil (?Paris).

Tryphon mesoxanthus Brullé, 1846. Hist. Nat. Insectes Hymén. 4:319. Type: ♀, Prov. de Goyaz, Brazil (?Paris).

Tryphon? rufithoracicus Cresson, 1868. Trans. Amer. Ent. Soc. 2:107. Type: ♂, Cuba (Havana).

The original descriptions of *Tryphon cerberus*, *T. lineolatus*, and of *T. mesoxanthus* indicate that they are more probably referable to *Colpotrochia* than to any tryphonine genus. The description of *Polyblastus aztecus* suggests that it belongs to the Ichneumoninae. Specimens answering to the description of *Tryphon claviventris* have been seen. These are a species of *Colpotrochia*, to which genus *claviventris* is hereby transferred. The descriptions of *Tryphon cinctus*, *T. exiguus*, and *T. rufithoracicus* give little hint of their proper systematic positions.

A few of the characters used in the descriptions may need explanation: The subtegular ridge is an elevated part of the mesopleurum just below the tegula (figs. 2, 3, 11, 16, 17, 23 to 31, and 44 to 48). It often assumes special shapes and thus provides taxonomic characters. The length of the fore wing, used as an indication of size, is taken from the apex of the tegula to the tip of the wing. The length of the face is taken from the lower margin of the antennal sockets to the clypeal

[2] *Polyrhysia*, commonly referred to the Tryphonini, is a mesoleiine genus whose genotype (*Tryphon tenuicornis* Gravenhorst) is congeneric with the genotype of *Synoecetes*, with which *Polyrhysia* is hereby synonymized.

foveae, and its width at its narrowest point. The length of the first tergite is taken from the center of the insertion of the large extensor muscle to its apex on the median line. The length of the petiolar area is its extreme length, measured to its latero-ventral corners. The length of most other bilaterally symmetric structures is taken on their midlines and their widths at their widest points.

ARTIFICIAL KEY TO THE GENERA OF TRYPHONINI

1. Areolet broadly sessile above; mesopleurum just below the wing base with a strong, laterally-projecting claw (fig. 43). Patagonian.... **Scolomus**
   Areolet petiolate or subpetiolate above (figs. 1, 12, 32, and 42), or absent; mesopleurum just below the wing base without a laterally projecting claw.... 2
2. First and second tergites completely fused, though separated by a sharp groove; apical part of abdomen curled under (fig. 32). Northwestern United States.... **Thibetoides**
   First and second tergites separated by a moveable suture; apical part of abdomen not curled under (figs. 1, 12, and 42).... 3
3. Frons with a median horn or nipple just above the antennal sockets, the horn not hollowed out above; abdomen in the American species black and yellow. Holarctic.... **Cosmoconus**
   Frons without a median horn or nipple except in the European *Monoblastus brachyacanthus*, which has the horn hollowed out above; abdomen in the American species black, ferruginous, or black and ferruginous.... 4
4. Second recurrent vein with a strong zig-zag near its center (fig. 42); tarsal claws pectinate only at the very base, apparently simple. Holarctic, **Tryphon**
   Second recurrent vein without a zig-zag, or when with a zig-zag, with a much weaker one than is shown in fig. 42; tarsal claws usually pectinate on the basal 0.4 or more.... 5
5. Upper margin of mesopleurum produced upwards and outwards as a lamella that is in contact with the lower edge of the tegula when the latter is not raised (figs. 16 and 17); ovipositor and its sheath upcurved (figs. 12 to 15 and 18 to 21). Holarctic.... **Erromenus**
   Upper margin of mesopleurum not capable of making contact with the lower margin of the tegula; ovipositor straight or downcurved (figs. 1, 4, 5, 8, 22, 33, and 34).... 6
6. Areolet present, rhombic, longer than high, its intercubital veins of nearly equal length and nearly equidistant from the second recurrent vein; occiput behind with a more or less distinct median notch. Holarctic, **Dyspetus**
   Areolet present or absent, when present oblique and subtriangular, the second intercubital vein longer than the first and nearer than the first to the second recurrent vein (fig. 1).... 7
7. Costula present, joining the petiolar area near its base; ovipositor with a blunt point (figs. 4 and 5). Nearctic.... **Polyblastus (Cophenchus)**
   Costula present or absent, when present joining the areola; ovipositor with a sharp point (figs. 1, 8, and 22).... 8
8. Clypeus very large, weakly arched longitudinally so that its profile is almost straight; lower part of hypostomal carina raised as a triangular tooth; length of ovipositor about 2.0 the apical depth of the abdomen. Mexican.... **Chiloplatys**
   Clypeus smaller, strongly arched longitudinally so that its profile is quite convex; lower part of hypostomal carina not raised as a triangular tooth; length of ovipositor less than 1.5 the apical depth of the abdomen.... 9
9. Tarsal claws strongly pectinate nearly or quite to the apex; second tergite without a transverse shallow groove; cheek less than 0.3 as long as the basal width of the mandible; ovipositor usually carrying a number of eggs (fig. 1). Holarctic.... **Polyblastus** (except the subgenus **Cophenchus**)
   Tarsal claws pectinate on at most their basal 0.7 *or* the second tergite with a postmedian broad, shallow, transverse impression, *or* the cheek more than 0.24 as long as the basal width of the mandible; ovipositor carrying only one egg at a time, usually without an egg.... 10

10. Distance between posterior condyles of the two mandibles conspicuously greater than that between the eyes at the level of the clypeal foveae; outer face of mandible at its basal 0.2 flat in cross section or weakly convex or concave, with large punctures; tarsal claws not pectinate to the apex; ovipositor straight, its sheath narrow (fig. 22). Holarctic, **Monoblastus**

Distance between posterior condyles of the two mandibles less than or subequal to that between the eyes at the level of the clypeal foveae; outer face of mandible at its basal 0.2 strongly convex in cross section, with only small inconspicuous punctures; tarsal claws pectinate nearly or quite to the apex; ovipositor decurved, its sheath broad (fig. 8). Holarctic, **Ctenochira**

Genus **Polyblastus**

Figures 1 to 5

Ovipositor bearing numerous eggs (fig. 1); *tarsal claws strongly pectinate to the apex except in P. flexus; clypeus broad.*

Fore wing 4.0 to 7.5 mm. long; body rather short and stout, the head and wings large, and the legs relatively slender; clypeus often quite large, evenly convex or with a weak median transverse ridge; median third of apical margin of clypeus usually somewhat turned outwards and fringed with closely spaced long setae; cheek 0.15 to 0.30 as long as the basal width of the mandible; posterior mandibular condyles separated from each other by a distance subequal to or somewhat greater than that between the eyes at the level of the clypeal foveae; outer face of mandible at its basal 0.2 more or less convex, with scattered punctures; postero-lateral corner of pronotum not unusually heavy nor projecting; subtegular ridge unspecialized (fig. 3) or in some species of the subgenus *Labroctonus* with a thin upright lamella that almost reaches the lower edge of the tegula (fig. 2); tegula convex; areolet present or absent, when present oblique; second recurrent vein evenly curved, with two well-separated bullae; nervellus broken at its lower 0.2 to 0.45; tarsal claws strongly pectinate to the apex (except that in *P. flexus* they are apparently simple); second tergite without grooves, impunctate, polished to mat and rugulose; ovipositor sheath narrowly clavate, flexible only at the base, projecting conspicuously beyond the end of the abdomen; ovipositor straight (or in *P. flexus* strongly decurved), 0.35 to 1.1 as long as the abdomen, capable of carrying a large number of eggs (figs. 1, 4, and 5).

This genus, *Ctenochira*, and *Erromenus* appear to be related, but may be grouped together only by characters which are rather vague or subject to so many exceptions as to be hardly worth discussing. Among these may be mentioned the rigid ovipositor sheath flexible only at the base, the (usually) strongly pectinate tarsal claws, and the widely separated bullae of the second recurrent vein. *Polyblastus* seems the least specialized of the three. It is divisible into three subgenera.

KEY TO THE SUBGENERA OF POLYBLASTUS

1. Areolet absent; eggs infuscate ..... subgenus **Labroctonus**
   Areolet present; eggs whitish 2
2. Costula strong, weak, or absent, when present joining the combined areola and basal area; ovipositor with a sharp point (fig. 1). subgenus **Polyblastus**
   Costula weak, joining the petiolar area near its base; ovipositor with a blunt point (figs. 4 and 5) ..... **Cophenchus,** new subgenus

Subgenus **Polyblastus**

Figure 1

Polyblastus Hartig, 1837. Wiegm. Arch. Naturg. 3: 155.
Type: (*Tryphon varitarsus* Gravenhorst) = *strobilator* Thunberg. Designated by Viereck 1912.

Areolet present; hind tibia either black with a white median band (the black and white color more or less replaced by ferruginous in some specimens of *Polyblastus pedalis* and the hind tibia uniformly black in the European *Polyblastus cothurnatus*) or whitish at the base and blackish at the apex; costula strong, weak, or absent, when present meeting the combined areola and basal area; ovipositor tapered to a sharp point; shell of eggs whitish or pale bluish.

The species of this subgenus known to us divide into two species groups, each with two definable subgroups.

1. *Strobilator* group. Hind tibia black with a white median band (but the black and white more or less replaced by ferruginous in some specimens of *pedalis* and the hind tibia uniformly black in the European *cothurnatus*); nervellus broken at its lower 0.3 to 0.45, moderately inclivous; costula strong, meeting the combined areola and basal area about 0.35 from its apex. Included are the Nearctic *tibialis* and *pedalis*, the Holarctic *strobilator*, *palaemon*, and *carbonarius*, and the European *cothurnatus* Gravenhorst 1829. These may be divided into subgroups, putting *strobilator*, *cothurnatus*, and *tibialis* together, and *palaemon*, *pedalis*, and *carbonarius* together. The characters distinguishing the two subgroups are pointed out in couplet 2 of the key to species.

2. *Fulvilinealis* group. Hind tibia whitish at the base and blackish at the apex; nervellus broken at its lower 0.2 to 0.35, strongly inclivous; costula strong, weak, or absent, when present joining the combined basal area and areola at about 0.4 from its apex. Included are the Nearctic *atrox* and *fulvilinealis*, the Holarctic *wahlbergi*, and the European *pinguis* Gravenhorst 1829. These may be divided into subgroups, putting *atrox* and *pinguis* together and *fulvilinealis* and *wahlbergi* together. The characters distinguishing the two subgroups are pointed out in couplet 6 of the key to species.

KEY TO THE AMERICAN SPECIES OF THE SUBGENUS POLYBLASTUS

1. Hind tibia blackish with a pale median band, or almost uniformly ferruginous; nervellus broken at its lower 0.3 to 0.45, moderately inclivous (*strobilator* group) 2
   Hind tibia basally whitish and apically blackish or infuscate; nervellus broken at its lower 0.2 to 0.35, strongly inclivous (*fulvilinealis* group) 6
2. Abdomen partly ferruginous, or sometimes entirely black; first tergite about 1.7 to 2.2 as long as it is wide at the apex; inner edge of second lateral propodeal area about 0.4 as long as the basal edge (*strobilator* subgroup) 3
   Abdomen entirely black; first tergite about 1.2 to 1.4 as long as it is wide at the apex; inner edge of second lateral propodeal area about 0.3 as long as the basal edge (*pedalis* subgroup) 4
3. Hind coxa entirely ferruginous; tegula yellow; basal 0.25 or less of clypeus black ..... 1. **tibialis**
   Hind coxa entirely or largely black; tegula blackish; basal 0.3 or more of clypeus black ..... 2. **strobilator**

4. Clypeus with its basal 0.2 or less black; under side of scape whitish, **3. palaemon**
   Clypeus with its basal 0.35 or more black; under side of scape black.....5
5. Coxae ferruginous.....**4. pedalis**
   Coxae black.....**5. carbonarius**
6. Coxae and most of all femora black; petiole and propodeum mostly scabrous, with very heavy carinae; a robust species (*atrox* subgroup).....**6. atrox**
   Coxae and femora ferruginous or stramineous; petiole and propodeum mostly polished, with weaker carinae; more slender species (*fulvilinealis* subgroup).....7
7. Propodeum and pleura largely or entirely ferruginous; costula strong, **7. fulvilinealis**
   Propodeum and pleura entirely black; costula weak or absent, **8. wahlbergi rufescens**

1. **Polyblastus (Polyblastus) tibialis** Cresson

Tryphon tibialis Cresson, 1864. Proc. Ent. Soc. Phila. 3: 280. Type: ♀, Ill. (Philadelphia).
Tryphon annulipes Cresson, 1868. Trans. Amer. Ent. Soc. 2: 108. Type: ♀, Ft. Resolution, Great Slave Lake (Philadelphia).
Prinopoda (!) *media* Hall, 1919. Psyche 26: 158. Type: ♀, Machias, Me. (Cambridge).

Second tergite usually ferruginous; hind coxa ferruginous.

Fore wing about 6.0 mm. long. Structurally similar to *P. strobilator* except that the face is slightly less densely punctate and less densely hairy.

Colored as in *P. strobilator* except as follows: clypeus except for its basal 0.25 or less, at least the under side of scape and pedicel, posterolateral corner of the pronotum, trochanters, and indefinite markings on the front and middle coxae yellowish; coxae ferruginous, the front and middle ones more or less yellowish.

Variations: Specimens from northwestern United States (Ashford and Westport, Wash. and Crescent City, Calif.) have the ferruginous markings of the abdomen reduced, sometimes to dark ferruginous margins at the base of the second tergite and at the apices of the second and third tergites. A series of specimens collected September 5, 1939 and June 21, 1940 on Pisgah Mountain, N. C. at 4800 to 5700 ft. are unusually slender and small (fore wing about 4.8 mm. long), and with tergites 2 to 4 pale ferruginous in the center and marked with fuscous along the sides. A specimen from Southbridge, Mass. is similar to those from Pisgah Mountain.

Specimens: Many males and females from ALBERTA (Bilby and Dapp); ARIZONA (near Alpine at 8200 ft. and Oak Creek Canyon); BRITISH COLUMBIA (Hundred Mile House, Likely, and Revelstoke in the Selkirk Mts.); CALIFORNIA (Coffee Creek at Big Flat in Trinity Co., Crescent City, and Redwood Creek in Humbolt Co.); COLORADO (Ft. Collins and Peaceful Valley); KANSAS (Lawrence); MAINE (Lincoln Co., Monmouth, and Southwest Harbor); MANITOBA (Churchill and Gillmann); MARYLAND (Takoma Park and 10 miles east of Washington, D. C.); MASSACHUSETTS (Holliston, North Adams, Southbridge, and South Hadley); MINNESOTA (Itasca Park, Kawishiwi River, and Pine Co.); NEW HAMPSHIRE (Jaffrey, Mt. Madison, and Pinkham Notch); NEW YORK (Bemus Point, McLean Reserve in Tompkins Co., Shokan, Troy, and Woodhaven); NORTH CAROLINA (Pisgah Mt. at 4800 to

5300 ft. and at 5000 to 5749 ft.); ONTARIO (Sudbury); OREGON (Siskyou Mts. in Jackson Co.); PENNSLYVANIA (Spring Brook); QUEBEC (Brome, Georgeville, Knowlton, St. Johns, Sherbrooke, and Stoneham); RHODE ISLAND (Hopkington, Kingston, and Westerly); VERMONT (Dummerston and Plainfield); WASHINGTON (Ashford, Quinault, and Westport) and WISCONSIN (Sawyer Co. and Trout Lake).

This species occurs from the Atlantic to the Pacific in the Transitional and Canadian zones. The record from Churchill, Man. indicates its presence in the Hudsonian Zone also. Its habitat is the heavy rank herbage and shrubs in or on the edge of moister woods, and often over patches of *Equisetum arvense*, where it is perhaps parasitic on the larvae of *Dolerus* that commonly infest this plant. Adults are commonest in June and early July. Early and late collecting dates of interest are: May 23 at Lawrence, Kans.; May 25 at South Hadley, Mass.; September 3 at Southbridge, Mass. and at Troy, N. Y.; and September 5 on Pisgah Mt., N. C. at 5000 to 5749 ft.

2. **Polyblastus (Polyblastus) strobilator** Thunberg

Figure 1

Ichneumon strobilator Thunberg, 1882. Mém. Acad. Sci. St. Pétersburg 8: 270. Type: ♂, no locality given (Upsala).

Tryphon varitarsus Gravenhorst, 1829. Ichneum. Europ. 1: 688, 2: 222. Types: ♂, ♀, central Europe (? Breslau).

Erromenus annulipes Ashmead, 1902. Proc. Wash. Acad. Sci. 4: 212. Type: ♀, Popof Is., Alaska (Washington).

Second tergite usually ferruginous; hind coxa black.

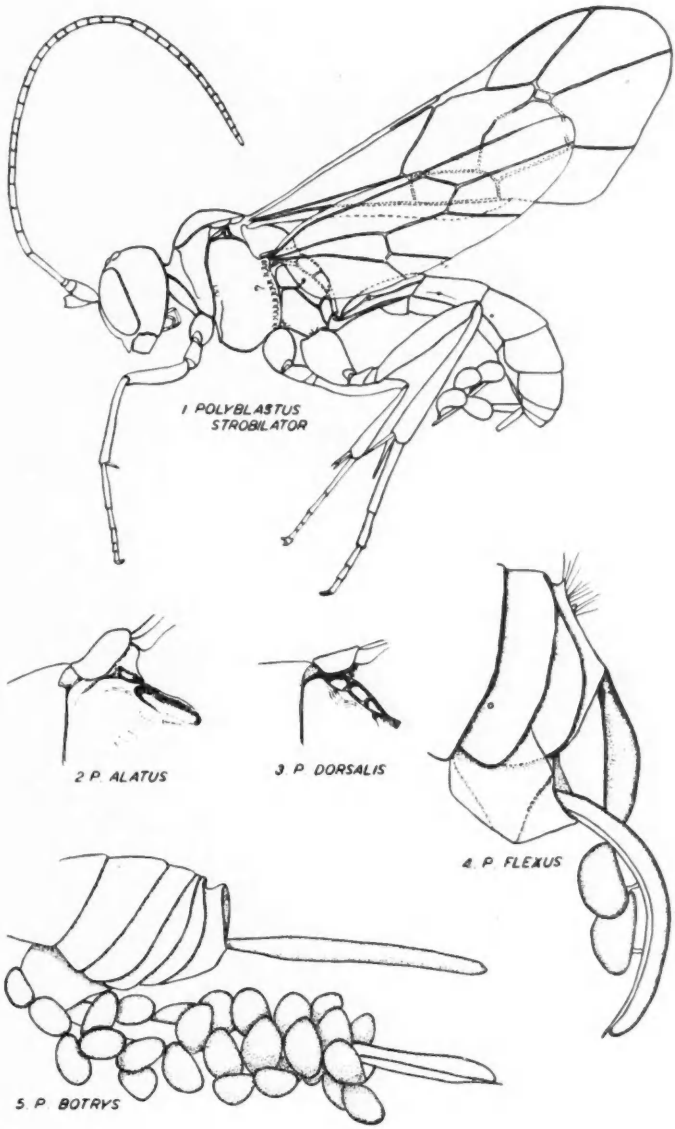
Fore wing about 5.8 mm. long; mesopleurum moderately punctate; propodeum and petiole subpolished; propodeum with sharp carinae, the costula strong; petiolar area hexagonal with rounded angles, usually without a median longitudinal carina, about 0.9 as long as the combined basal area and areola; first tergite about 2.1 (♂) or 1.8 (♀) as long as broad, rather weakly arched above, its dorsal carinae extending about 0.8 its length.

Black. Apical 0.6 of clypeus, legs except as noted below, and second and third tergites ferruginous; mandible except apical part, palpi, trochanters, fore and middle coxae of male, and indistinct markings on fore and middle tibiae and tarsi yellowish; tegula black; basal part of fore and middle coxae blackish; hind coxa black; hind first trochanter and base of hind femur infuscate; apex of hind femur black; hind tibia and tarsus black, yellowish white as follows: band occupying about 0.4 the length of the tibia centering just above the middle, tibial spurs, and basal 0.35 of first three tarsal segments.

Variations: The abdomen varies from entirely black (one specimen from Katmai, Alaska) to black with second and third incisures bordered with ferruginous (some specimens from Mt. Rainier, Wash. at 2700 ft.) to black with the second, third, and fourth, and extreme apex of first

EXPLANATION OF PLATE I

FIG. 1. *Polyblastus strobilator*, ♀, side view. FIG. 2. *Polyblastus alatus*, subtegular ridge. FIG. 3. *Polyblastus dorsalis*, subtegular ridge. FIG. 4. *Polyblastus flexus*, ♀, end of abdomen. FIG. 5. *Polyblastus botrys* ♀, end of abdomen.


1. POLYBLASTUS STROBILATOR
2. P. ALATUS
3. P. DORSALIS
4. P. FLEXUS
5. P. BOTRYS

segment ferruginous (specimens from Sweden and from Stoneham, Que.). Occasional specimens from the West (Katmai, Alaska; some from Mt. Rainier, Wash. at 2700 ft.; Cloudcroft, N. M.; Boulder, Colo.; Pingree Park, Colo.; and at 11000 ft. in the Rocky Mt. National Park, Colo.) have the hind femur entirely black. The hind coxa may have as much as the apical 0.4 yellowish or ferruginous (most often in males from the East), and the scape may be yellow beneath. As a rule the black markings are most extensive in specimens from the West.

Specimens: Many males and females from: ALASKA (Anchorage, Fairbanks, and Katmai); ALBERTA (Bilby, Edmonton, and Slave Lake); BRITISH COLUMBIA (Agassiz, Chilcotin, Chilliwack, Clinton, Hope Summit, Hundred Mile House, Kaslo, North Vancouver, Revelstoke in the Selkirk Mts., and Vancouver Island); CALIFORNIA (Summit); COLORADO (Boulder, above timberline on Long's Peak Trail, Pingree Park, at 11000 ft. in Rocky Mt. National Park, and Rockwood); IOWA (Ames); MASSACHUSETTS (West Springfield); MICHIGAN (Crawford Co., Midland Co., Otsego Co., Roscommon Co., and Saginaw Co.); MINNESOTA (Itasca Park and Lake Itasca); MONTANA; NEW HAMPSHIRE (Base Station, Mt. Madison, and Randolph); NEW MEXICO (Cloudcroft); NEW YORK (southern Adirondack Mountains and Saranac Lake); ONTARIO (Bells Corners, Britannia, Ottawa, Sudbury, and Wabamic); OREGON (Aneroid Lake in the Blue Mountains at 7500 ft., Cannon Beach, Cornucopia at 7100 ft., Corvallis, Independence, Kiger's Island, Linn Co., Newport, Scappoose, Seaside, Wallowa Lake on the Aneroid Lake Trail, and Warrenton); QUEBEC (Burbridge, near Cookshire, Gracefield, Hull, Lac Mercier, Maniwaki, Montreal, Mt. Lyall at 1500 ft., and Stoneham); SASKATCHEWAN (Antelope Lake, Prince Albert National Park, Redberry, Saskatoon, and Waskesiu); and WASHINGTON (Arlington, Ashford, Chinook Pass summit, Eatonville, Elbe, Mt. Rainier at 2700 ft., 2900 ft., and 4700 ft., Snoqualmie Pass, and Westport).

This species occurs from the Atlantic to the Pacific in the Transitional, Canadian, and Hudsonian zones. In the East, it is mostly in the Canadian Zone and has not been taken south of Massachusetts, New York, Michigan, and Minnesota. In the West, it occurs southward to New Mexico and is common in the Transitional. Adults are on the wing throughout most of the growing season, being most common in the summer. Early and late collecting dates are April 8 at Kiger's Island, B. C; May 2 at Scappoose, Oreg.; May 11 at Agassiz, B. C.; October 14 at Montreal, Que.; and October 19 at Chilliwack, B. C. The favored habitat is low damp spots among grasses and sedges. In suitable northern localities the species is often abundant. It is reported to be common over most of Europe, where it has been reared as a parasite of *Dolerus*. Judging from the adult habitat in America, this genus is probably its usual host.

3. **Polyblastus** (**Polyblastus**) **palaemon** Schiödte

Polyblastus Palaemon Schiödte, 1838. Rev. Zool. (Soc. Cuv.) 1: 140; 1839, Mag. de Zool. 1: ins. pl. 6–10: 13. Type: ♀, Denmark (? Copenhagen).

Second tergite black; hind coxa ferruginous; under side of scape whitish.

Fore wing about 5.0 mm. long. Structurally similar to *P. pedalis*, but slightly less robust and less strongly sculptured.

Colored as in typical *P. pedalis* except as follows: Clypeus except extreme base, entire under side of scape, mandible except the apical part, most of trochanters and front and middle coxae of the male, and the under side of the hind coxa of the male yellowish white.

Many features in the coloration of this species are like those of *P. tibialis*, perhaps indicating a close relationship with that species.

Specimens: 3♂, Slave Lake, Alta., Aug. 14, 1924, O. Bryant (Washington and Townes); ♀, The Pas, Man., July 31, 1937, R. H. Daggy (St. Paul).

The species occurs also in northern and central Europe.

4. **Polyblastus (Polyblastus) pedalis** Cresson

Tryphon pedalis Cresson, 1864. Proc. Ent. Soc. Phila. 3: 273. Type: ♂, Ill. (Philadelphia).

Bassus Bouleti Provancher, 1874. Nat. Canad. 6: 32. Type: ♀, Que. (Quebec).

Second tergite black; hind femur and coxa ferruginous; under side of scape black.

Fore wing about 5.8 mm. long; mesopleurum moderately punctate; propodeum and petiole subpolished to somewhat mat and scabrous; propodeum with heavy sharp carinae, the costula strong; petiolar area hexagonal with sharp angles, usually with a median longitudinal carina, about 1.1 as long as the combined basal area and areola; first tergite strongly arched above, about 1.25 as long as broad, its dorsal carinae strong, extending about 0.85 its length.

Black. Apical 0.6 of clypeus, legs except hind tibia and tarsus, and apical 0.4 of mandible except for the black apical edge, ferruginous; basal 0.6 of mandible, palpi, tegula, bases of wings, and postero-lateral corner of pronotum white; apex of hind femur blackish; hind tibia and tarsus black, white as follows: a band occupying about 0.4 of the tibia, centering just above the middle; basal 0.33 of basitarsus, basal 0.25 of second tarsal segment, and the extreme base of the third tarsal segment; hind tibial spurs whitish with their apices dusky.

Variations: A number of specimens from Mt. Rainier, Wash. and the vicinity have the abdomen unusually broad, perhaps because they developed in very short host cocoons. Many specimens from western Washington, Oregon, and British Columbia have the contrasted black and white of the hind tibia and tarsus more or less altered into ferruginous, with a correlated tendency to have the extent of the white or whitish markings on the hind tibia and tarsus reduced. All degrees of coloration from black and white to dusky ferruginous and ferruginous, to almost uniformly ferruginous hind tibia and tarsus occur among specimens from the same locality. Extensive collecting in various habitats and at altitudes of sea level to above timberline (about 6000 ft.) in the Northwest have failed to reveal any correlation of this tendency with a particular locality or habitat. As a rule, the smaller specimens are those that show this atypical coloration most frequently and most strongly.

Specimens: Many males and females from ALBERTA (Athabasin, Banff, Beaver Lodge, Cypress Hills, Edmonton, Gull Lake, Lake

Louise at 5600 ft., Wabamun, and Wetaskewin); ARIZONA (near Alpine at 8200 ft.); ARKANSAS (Polk Co.); BRITISH COLUMBIA (Clinton, Cultus Lake, Hazleton, Kokanee Mt. at 8000 ft., Likely, Nannaimo Biological Station, Revelstoke Mt. in the Santa Cruz Mts. at 6000 ft., and Robson at 1450 ft.); CALIFORNIA (Berkeley, Lake City, Redwood Corralitos, San Anselmo, and Taliac Lake at Tahoe); COLORADO (Georgetown, Green Mt. Falls, Veta Pass, and Westcliffe); CONNECTICUT (Lyme, Putnam, and Salisbury); ILLINOIS (Algonquin and Havana); MAINE (Bar Harbor, Casco, Echo Lake on Mt. Desert Island, and Lincoln Co.); MANITOBA (Aweme); MARYLAND (Bowie, Cabin John, Plummers Is., and Takoma Park); MASSACHUSETTS (Lexington and Needham); MICHIGAN (Chippewa Co., Midland Co., Missaukee Co., Ontonagon Co., and Roscommon Co.); MINNESOTA (Itasca State Park, Norman Co., Owatonna, St. Paul, and Two Harbors in Lake Co.); NEW BRUNSWICK (Fredericton); NEW HAMPSHIRE (summit of Mt. Washington, Pinkham Notch, and Randolph); NEW JERSEY (Moorestown); NEW MEXICO (Beulah, Pecos National Forest, and Tajique); NEW YORK (Artists Bridge in Essex Co., Bemus Point, Black Brook in Clinton Co., Canajoharie, Eastport, Hancock, Ithaca, McLean in Tompkins Co., Oneonta, Poughkeepsie, and Saranac Lake); NORTH CAROLINA (Pisgah Mt. at 4800 to 5300 ft., and at 5000 to 5749 ft.); NORTH WEST TERRITORIES (Cameron Bay on Great Slave Lake); NOVA SCOTIA (Baddeck); OHIO (Cantwell Cliffs); ONTARIO (Constance Bay, Jockvale, Kearney, Moosonee, Ottawa, Smoky Falls on the Mattagami River, Sudbury, and Toronto); OREGON (Cannon Beach, Corvallis, Diamond Lake in Douglas Co., Hood River, Meacham, 6 miles south of Parkdale, Seaside, and Soda Springs in Benton Co.); PENNSYLVANIA (Lehigh Gap and Spring Brook); QUEBEC (Aylmer, Brome, Cascapedia, Hemmingford, Hull, Kazubazua, Knowlton, Magog, Montreal, Mt. Lyall at 1500 ft., Stoneham, and Wright); RHODE ISLAND (Hopkington and Westerly); SASKATCHEWAN (Earl Grey, Redberry, and Waskesiu); SOUTH DAKOTA (Brookings and Spearfish); TENNESSEE (Gatlinburg and Knoxville); TEXAS (Trinity); VERMONT (Laurel Lake at Jacksonville, Plainfield, and summit of Mt. Mansfield); VIRGINIA (Chain Bridge near Rosslyn); WASHINGTON (Ashford, Mt. Rainier at 2700 ft., 2900 ft., 3800 ft., 4200 ft., 4700 ft., 5000 ft., and at 5300 ft., Northbend in King Co., Olympia at 5000 ft., Puyallup, Snoqualmie Pass, and Westport); and WEST VIRGINIA (Bolivar).

This species is the most abundant and widespread member of its genus in North America. It occurs from the Atlantic to the Pacific in the Hudsonian, Canadian, Transitional, and Upper Austral zones, being scarce in the Upper Austral. In the Hudsonian and Canadian zones it is common among ericaceous shrubs in woods and in the open, while in the Transitional Zone it is usually restricted to the undergrowth of moister woods. Adults are most common in June and July though individuals may be taken in almost any part of the season. On Mt. Rainier in 1940, we found that there was a peak of abundance at about 2900 ft. around July 10, a peak of abundance at about 4800 ft. around July 18, and a peak of abundance at about 5300 ft. around August 15. Noteworthy early and late dates of collection are April 6 at Berkeley, Calif.; May 2 at Kazubazua, Que.; May 4 at Cantwell Cliffs, Ohio;

September 2 at Wabamun, B. C.; September 20 at Bolivar, W. Va.; and October 27 at Cultus Lake, B. C.

Specimens before us have been reared from *Cladius isomerus* at Puyallup, Wash., by W. W. Baker, from a sawfly on *Betula populifolia* at Bar Harbor Me., and from *Blennocampa spiraeae* (no locality data). Procter (1938, Biol. Surv. Mt. Desert Region, 6:412) reports it as a parasite of *Croesus latitarsis*.

5. **Polyblastus (Polyblastus) carbonarius** Gravenhorst

Tryphon carbonarius Gravenhorst, 1829. Ichneum. Europ. 2: 141. Type: ♂, Austria (? Breslau).

Second tergite black; femora ferruginous; hind coxa black.

Fore wing about 6.3 mm. long. Structurally similar to *P. pedalis* but slightly more robust and more strongly sculptured.

Colored as in typical *P. pedalis* except as follows: coxae, first trochanters, posterior corner of pronotum, and sometimes the tegula black; second trochanters more or less infuscate.

Specimens: ♀, Edmonton, Alta., June 15, 1937, F. O. Morrison (Townes); ♂, Mt. Washington, N. H., 6000 ft., July 11, 1946, M. Townes and J. Peck (Townes).

The species occurs also in northern Europe.

6. **Polyblastus (Polyblastus) atrox,** new species

Femora and coxae black; hind tibia palest at the base.

Fore wing 6.2 mm. long; mesopleurum rather strongly and densely punctate; propodeum and first tergite strongly scabrorugose, with heavy strong carinae; costula moderately strong; petiolar area hexagonal, with a median longitudinal carina, about 1.5 as long as the combined basal area and areola; first tergite about 1.1 as long as broad, strongly arched towards its apex, its dorsal carinae reaching almost to the apex.

Black. Apical 0.68 of clypeus and mandible except at base and apex dark ferruginous; palpi brown; tegula black; bases of wings yellowish white; legs black, pale yellow as follows: fore and middle tibiae and tarsi, apices of fore and middle femora, basal 0.75 of hind tibia, tibial spurs, and basal 0.8 of first and basal 0.35 of second segments of hind tarsi; second trochanters dusky yellowish, partly infuscate.

Type: ♂, Norway Bay, Que., July 20, 1941, G. A. Hobbs (Ottawa).

7. **Polyblastus (Polyblastus) fulvilinealis** Hall

Polyblastus fulvilinealis Hall, 1919. Psyche. 26: 155. Types: ♂, ♀, Riverside, Mass. and Auburndale, Mass. (Cambridge).

Thorax largely ferruginous.

Fore wing about 6.0 mm. long; mesopleurum rather finely punctate; propodeum and first tergite polished, the propodeum in part weakly punctate; propodeum with strong sharp carinae; costula strong; petiolar area subcircular, without a median longitudinal carina, about 1.0 as long as the combined basal area and areola; first tergite about 1.25 as long as broad, weakly arched above, its dorsal carinae weak and short, extending about 0.4 its length.

Black, the thorax with extensive ferruginous markings which may cover all of the thorax except for most of the mesoscutum and mesosternum or may be reduced to extensive stains on the mesopleurum and the propodeum. Clypeus, mandible except apex, palpi, under side of scape and pedicel, tegula, and hind corner of pronotum yellowish white; flagellum apically dusky ferruginous; legs ferruginous except as follows: front and middle trochanters and often their coxae more or less pale yellow; hind tibia, tibial spurs, and tarsus black with the basal 0.2 to 0.8 of the hind tibia whitish.

Specimens: Males and females from CONNECTICUT (Canterbury, Lebanon, and Ledyard); MAINE (Echo Lake and Mt. Cadillac, both on Mt. Desert Island); MARYLAND (Cabin John and Takoma Park); NEW HAMPSHIRE (Jaffrey, foot of Mt. Madison, and Randolph); NEW YORK (Farmingdale and Loch Muller in Essex Co.); NORTH CAROLINA (Pisgah Mt. at 4800 to 5300 ft.); PENNSYLVANIA (Harrisburg, Inglenook in Dauphin Co., Lehigh Gap, North Bloomfield, and Spring Brook); QUEBEC (Knowlton); RHODE ISLAND (Ashaway, Hopkington, and Westerly); and VERMONT (Laurel Lake at Jacksonville).

This species occurs in shaded rank shrubbery and herbage in the Transitional Zone of the East from Quebec to the District of Columbia and in the mountains to southern North Carolina. It is commonest from the middle of June through August, but has been caught as early as May 24 at North Bloomfield, Pa. and as late as October at Harrisburg, Pa.

8. **Polyblastus (Polyblastus) wahlbergi rubescens,** new subspecies

Polyblastus Wahlbergi sensu lato Roman, 1931. Arkiv. för Zool. 23A, no. 6: 17. Recorded from Nova Scotia.

Basal part of hind tibia whitish; hind femur mostly ferruginous; thorax black.

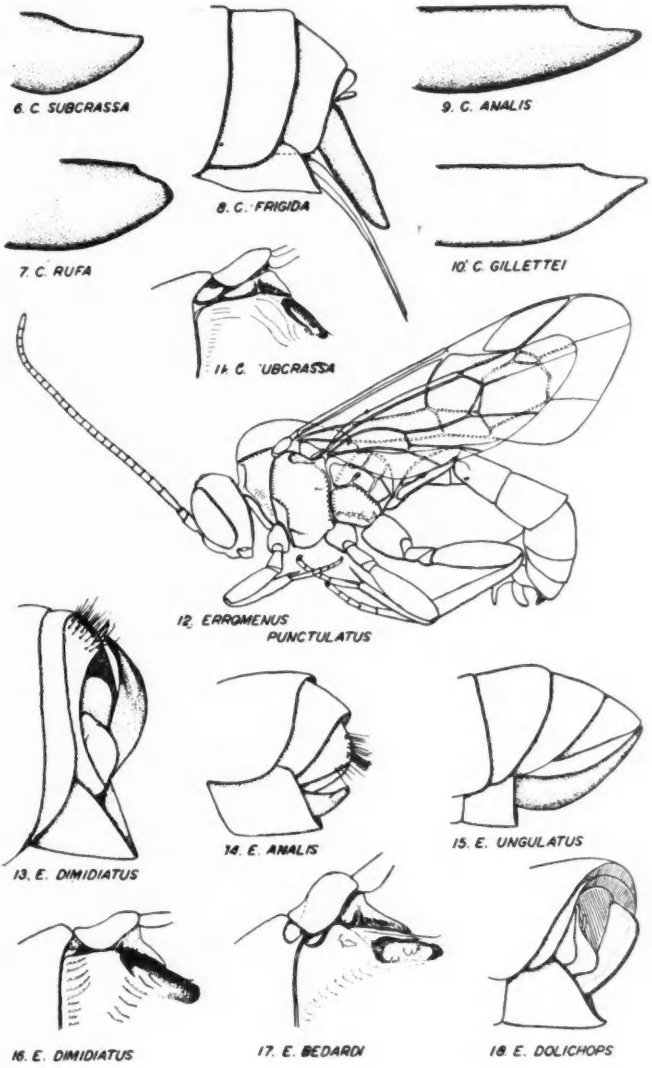
Fore wing about 5.5 mm. long; mesopleurum rather sparsely and finely punctate; propodeum and petiole subpolished; propodeum with sharp carinae; costula weak or absent; petiolar area subcircular, without a median longitudinal carina, about 1.0 as long as the combined basal area and areola; first tergite about 1.45 as long as wide, weakly arched above; dorsal carinae of first tergite extending about 0.6 its length.

Black. Apical 0.6 of clypeus pale ferruginous or yellowish; mandible except apex, palpi, under side of scape and pedicel, tegula, posterior

---

EXPLANATION OF PLATE II

FIG. 6. *Ctenochira subcrassa*, ovipositor sheath. FIG. 7. *Ctenochira rufa*, ovipositor sheath. FIG. 8. *Ctenochira frigida*, ♀, end of abdomen. FIG. 9. *Ctenochira analis*, ovipositor sheath. FIG. 10. *Ctenochira gillettei*, ovipositor sheath. FIG. 11. *Ctenochira subcrassa*, subtegular ridge. FIG. 12. *Erromenus punctulatus*, ♀, side view. FIG. 13. *Erromenus dimidiatus* ♀, end of abdomen. FIG. 14. *Erromenus analis* ♀, end of abdomen. FIG. 15. *Erromenus ungulatus* ♀, end of abdomen. FIG. 16. *Erromenus dimidiatus*, subtegular ridge. FIG. 17. *Erromenus bedardi*, subtegular ridge. FIG. 18. *Erromenus dolichops* ♀, end of abdomen.


6. C. SUBCRASSA
9. C. ANALIS
8. C. FRIGIDA
7. C. RUFA
10. C. GILLETTEI
11. C. SUBCRASSA
12. ERROMENUS PUNCTULATUS
13. E. DIMIDIATUS
14. E. ANALIS
15. E. UNGULATUS
16. E. DIMIDIATUS
17. E. BEDARDI
18. E. DOLICHOPS

corner of pronotum, front and middle legs, apical margin of second and third tergites, and usually a median area extending from the base to the apex of the second and third tergites yellowish white; hind coxa and femur ferruginous, the apical part of the femur infuscate; hind trochanters yellowish white; hind tibia, tibial spurs, and tarsus black, the basal 0.3 to 0.8 of the hind tibia white to pale yellow.

The typical *P. wahlbergi* Holmgren 1855 of Europe differs in that it has the hind femur entirely castaneous, instead of ferruginous with the apical part of the femur castaneous or infuscate as in American specimens. The European *wahlbergi tener* Habermehl 1909 is colored as in *rubescens* but lacks the whitish marks on the tergites, and the European *wahlbergi wesmaeli* Holmgren 1855 is like *tener* but differs from *tener* and further from *rubescens* in having the hind coxa black.

Type: ♀, Laurentian Mountains, five to twenty miles north of Stoneham, Que., June 21, 1938, H. & M. Townes (Townes).

Paratypes: ♀, Pyziton, Clay Co., Ala., H. H. Smith (Washington). ♂, ♀, Edmonton, Alta., July 2 and 3, 1945, E. H. Strickland (Edmonton and Townes). ♀, Milton, Mass., June 11, 1899 (Cambridge). ♀, Randolph, N. H., July 4, 1946, M. Townes & J. Peck (Townes). ♂, Sixmile Creek, Ithaca, N. Y., June 22, 1937, P. P. Babiy (Townes). ♂, Ringwood, Tompkins Co., N. Y., May 17, 1936, H. Townes (Townes). ♀, Pisgah Mt., 5000 to 5749 ft., N. C., Sept. 5, 1939, H. & M. Townes (Townes). ♀, Spring Brook, Pa., June 27, 1945, H. Townes (Townes). ♀, collected with the type (Townes). ♀, Waskesiu, Sask., June 21, 1938, J. G. Rempel (Townes).

This species occurs in the undergrowth of woods.

Subgenus **Cophenchus,** new subgenus

Figures 4 and 5

Genotype: *Polyblastus* (*Cophenchus*) *flexus*, new species.

Areolet present; hind tibia pale with the apex infuscate; costula weak, joining the petiolar area at its extreme base; ovipositor of even depth throughout, its dorsal valve suddenly rounded off at the apex to form a blunt point; shell of eggs whitish; mesopleurum rather sparsely and finely punctate; propodeum and petiole subpolished; propodeum with rather strong carinae; petiolar area hexagonal, without a median longitudinal carina, about 1.3 as long as the combined basal area and areola; first tergite about 1.3 as long as wide, moderately arched above.

The two known species of this subgenus are remarkably diverse in the shape and length of the ovipositor, shape of the clypeus and head, and place of attachment of the egg stalk to the egg.

KEY TO THE SPECIES OF THE SUBGENUS COPHENCHUS

1. Apical margin of clypeus strongly convex; temple not unusually wide, in dorsal view much shorter than the eye; ovipositor straight; egg with stalk attached at one end (fig. 5) ..... 1. **botrys**

   Apical margin of clypeus nearly straight; temple wide, in dorsal view much longer than the eye; ovipositor strongly downcurved; egg with stalk attached subapically (fig. 4) ..... 2. **flexus**

1. **Polyblastus (Cophenchus) botrys,** new species

Figure 5

Apical margin of clypeus strongly convex; ovipositor straight.

Fore wing about 4.8 mm. long; clypeus about 2.5 as wide as long, its apical margin strongly convex; temple rounded off behind eye, from a dorsal view about 0.8 as long as eye; dorsal carinae of first tergite extending about 0.75 its length; ovipositor straight, about 1.1 as long as the abdomen; ovipositor sheath about 1.6 as long as the first tergite. The ovipositor is capable of carrying a great number of eggs, so that when loaded it looks like a miniature bunch of grapes. One specimen at hand has about fifty eggs on its ovipositor, making a bunch larger than the insect's abdomen. Egg normal for the tribe, with the stalk attached at its smaller end (fig. 5).

Black. Clypeus, gastrocoeli, and apical margins of first three tergites light ferruginous; mandible except at its apex, palpi, pedicel, scape, underside of basal part of flagellum, tegula, and posterior corner of pronotum pale yellow. Legs pale yellow with the hind femur except apically pale ferruginous, the apical 0.2 of the hind tibia fuscous, and the hind tarsus fuscous with the basal part of each segment more or less pale.

Type: ♀, Laurentian Mountains, five to twenty miles north of Stoneham, Que., June 21, 1938, H. & M. Townes (Townes).

Paratypes: ♀, Aweme, Man., July 9, 1924 R. D. Bird (Ottawa). ♀, South Hadley, Mass., May 25, 1936, M. C. Townes (Townes). ♂, Midland Co., Mich., May 12, 1941, R. R. Dreisbach (Townes). ♀, Midland Co., Mich., June 1, 1940, R. R. Dreisbach (Townes). ♂, Saginaw Co., Mich., June 1, 1941, R. R. Dreisbach (Townes). ♀, Randolph, N. H., July 5, 1946, M. Townes & J. Peck (Townes).

2. **Polyblastus (Cophenchus) flexus,** new species

Figure 4

Apical margin of clypeus nearly straight; ovipositor decurved.

Fore wing about 4.7 mm. long; clypeus about 3.4 as wide as long, its apical margin almost straight; temple slightly expanded behind the eye, from a dorsal view about 1.3 as long as the eye; dorsal carinae of first tergite extending about 0.33 its length; ovipositor strongly downcurved, making almost a semicircle, measured along the curve about 0.4 as long as the abdomen; ovipositor sheath about 0.26 as long as the first tergite; egg with its stalk attached about 0.3 from one end, thus differing from the eggs of all other Tryphoninae known to us (fig. 4).

Black. Basal half of mandible, palpi, posterior corner of pronotum, tegula, and wing bases pale yellow; apical half of mandible red-brown shading to black at the tip; clypeus, underside of scape and pedicel, and legs light ferruginous, the hind tibia narrowly and segments of the hind tarsus broadly infuscate apically; first tergite blackish brown, the remaining tergites reddish brown to dark brown, margined with paler, or the apical ones entirely ferruginous.

Type: ♀, Edmonton, Alta., June 19, 1937 (Townes).

Paratypes: ♂, Likely, B. C., July 2, 1938, G. S. Walley (Ottawa). ♀, Laniel, Que., June 11, 1942, O. Peck (Ottawa). 2♀, on cherry, Edmonton, Alta., June 8, 1946, Wm. R. M. Mason (Mason, Townes). ♀, Edmonton, Alta., June 29, 1946, Wm. R. M. Mason (Mason).

Subgenus **Labroctonus**

Labroctonus Foerster, 1868. Verh. Naturh. Ver. Preuss. Rheinlande. 25: 195. Type: *Tryphon articulatus* Cresson. Included by Davis 1897.
Nemioblastus Thomson, 1883. Opusc. Ent. 9: 901. Type: *Polyblastus* (*Nemioblastus*) *albicoxa* Thomson. Designated by Viereck 1914.

Clypeus unusually wide; areolet absent; costula present, joining the combined areola and basal area about 0.33 from its apex; ovipositor tapered to a sharp point; shell of egg smoky to black.

The American species of *Labroctonus* are divisible into four groups on minor differences in the pectinations of the tarsal claws, correlated with a very few other characters. The Palaearctic species are not discussed because only a little material with doubtful determinations is available.

1. *Dorsalis* group. Subtegular ridge rounded (fig. 3); apical edge of pecten of tarsal claws curved, the apical pecten teeth appearing shorter and the pecten not reaching the apical tooth of the claw, so that there is a distinct gap between the pecten and the claw apex. The Nearctic *dorsalis* and *jugatus* are included.

2. *Alatus* group. Subtegular ridge produced as a small sharp upright lamina (fig. 2); apical edge of pecten of tarsal claws curved, the apical pecten teeth appearing shorter and the pecten not reaching the apical tooth of the claw, so that there is a distinct gap between the pecten and the claw apex. The Nearctic *alatus*, *bimacula*, and *rutilus* are included.

3. *Articulatus* group. Subtegular ridge rounded; pecten of tarsal claws with a straight apical edge, extending nearly or quite to the apical tooth of the claw. The Nearctic *productus*, *gloriosus*, *galaphilus*, *articulatus*, *peckae*, and *buccatus*, and the Holarctic *stenocentrus* are included.

4. *Expletus* group. Similar to the *articulatus* group but the tarsal claws relatively long and the body build stouter and ovipositor sheath shorter (3.8± as long as broad) than in other groups (ovipositor sheath 4.5 as long as broad). The Nearctic *expletus* is the only species included.

KEY TO THE AMERICAN SPECIES OF THE SUBGENUS LABROCTONUS

1. Mesopleurum just below the tegula produced upwards and outwards as a thin sharp-edged flange, almost reaching the lower edge of the tegula (fig. 2); abdomen beyond the first tergite largely ferruginous. 2
   Mesopleurum just below the tegula forming a rounded longitudinal ridge, not produced upwards (fig. 3). 4
2. Thorax ferruginous. . . . . 4. **rutilus**
   Thorax black. 3
3. Lateral margin of posterior part of mesoscutum produced upwards as a flange that is about 0.7 as wide as the tegula; upper portion of vertical ridge on mesonotum that is just behind the base of the fore wing produced as a lobe that is about 1.1 as high as wide; cheek black. . 5. **alatus**
   Lateral margin of posterior part of mesoscutum produced upwards as a flange that is about 0.3 as wide as the tegula; upper portion of vertical ridge of mesonotum that is just behind the base of the fore wing produced as a lobe that is about 0.5 as high as wide; cheek usually white. . . . . 3. **bimacula**

4. First and second tergites largely or entirely ferruginous; fore wing about 7.3 mm. long; ovipositor sheath about 3.8 as long as wide ..... 13. **expletus**
   First and second tergites black, with whitish, ochraceous, or dark brown apical margins and sometimes the second tergite with a median pale area; fore wing about 4.0 to 6.3 mm. long; ovipositor sheath about 4.5 as long as wide 5
5. Pronotum largely or entirely ferruginous 6
   Pronotum black except for its whitish postero-lateral corner 7
6. Scutellum ferruginous; propodeum black; pectination of tarsal claws dense, the apical pecten tooth separated from the apical point of the claw by about its diameter ..... 7. **gloriosus**
   Scutellum black; propodeum more or less ferruginous; pectination of tarsal claws moderately dense, the apical pecten tooth separated from apical point of the claw by several times its diameter ..... 2. **jugatus**
7. Apical pecten teeth of tarsal claws much shorter than the basal ones so that the edge of the pectination has a sharp inward curve; pecten teeth separated by about 1.2 their diameter in the male and by about 1.5 their diameter in the female; lower half of the mesopleurum with weak, sparse punctures; second, third, and sometimes the fourth tergites with a median pale area or with the apical and basal pale margins strongly widened medially ..... 1. **dorsalis**
   Apical pecten teeth of tarsal claws as long as the basal ones so that the edge of the pectination is straight to the apex; pecten teeth separated by about 0.8 their diameter in the male and by about 1.0 their diameter in the female; lower part of mesopleurum with somewhat stronger and denser punctures; tergites without a median pale area, the apical pale margin uniformly narrow 8
8. Hind coxa dark castaneous to black, its extreme apex often more or less yellowish 9
   Hind coxa ferruginous, sometimes more or less unevenly infuscate 11
9. Hind femur ferruginous ..... 9. **stenocentrus**
   Hind femur castaneous to black 10
10. Tergites without a conspicuous pale hind margin; hind tibia not infuscate basally ..... 10. **peckae**
    Tergites with a conspicuous pale hind margin; hind tibia weakly infuscate basally ..... 11. **articulatus**
11. Scape black, indistinctly dusky ferruginous in front; front and middle coxae ferruginous; as seen from above, the temple about 0.85 to 1.1 as long as the eye ..... 12. **buccatus**
    Scape pale yellow in front; front and middle coxae white to yellow; as seen from above, the temple about 0.60 to 0.80 as long as the eye 12
12. Cheek black; combined areola and basal area longer than the petiolar area; upper bulla in second recurrent vein separated usually by less than half its length from the cubital vein ..... 6. **productus**
    Cheek usually white; combined areola and basal area shorter than the petiolar area; upper bulla in second recurrent vein separated usually by more than half its length from the cubital vein ..... 8. **galaphilus**

1. **Polyblastus (Labroctonus) dorsalis** Provancher, new combination

Figure 3

Tryphon dorsalis Provancher, 1879. Nat. Canad. 11: 253; Faune, p. 411. Type: ♀, Quebec (Quebec).

Pecten of tarsal claws shorter apically, not reaching the apical tooth of the claw; pronotum black; tergites blackish marked with stramineous.

Fore wing about 4.4 mm. long; as seen from above, the temple about 0.70 as long as the eye; lower half of mesopleurum with sparse, small or very small punctures; mesopleurum just below the tegula with a rounded longitudinal ridge; pectination of tarsal claws moderately dense, the apical teeth not projecting nearly as far as the subbasal ones

and the pecten not extending the full length of the claw so that there is a conspicuous gap between the pecten and the apical tooth of the claw; body build medium.

Black. Clypeus, usually the cheek, mandible except its apex, palpi, hind corner of pronotum, tegula, wing bases, coxae, trochanters, and all except apical 0.15± of hind tibia whitish yellow; scape and pedicel light to dark stramineous; extreme apex of first tergite and usually of the fifth and following tergites light to dark stramineous; second to fourth tergites some shade of stramineous with a large dark brown triangle on each side, the triangle apices pointing inwards and often meeting, or in many specimens the dark brown color on the second to fourth tergites is so extensive that only the basal and apical margins, widened medially, are stramineous. Front and middle legs beyond the trochanters ferruginous; hind femur ferruginous or sometimes pale castaneous; apical 0.15± of hind tibia fuscous, its tibial spurs stramineous; hind tarsus fuscous, the segments, especially the first segment, pale basally.

Specimens: Males and females from ALBERTA (Edmonton and Slave Lake); BRITISH COLUMBIA (Canim Lake); CALIFORNIA (Felton in the Santa Cruz Mts. at 300 to 500 ft., Redwood Corralitos in the Santa Cruz Mts., and Siskiyou Co.); COLORADO; CONNECTICUT (East River); MAINE (Orono); MANITOBA (Aweme); NEW HAMPSHIRE (Randolph); NEW YORK (Bemus Point, Cranberry Lake, Ithaca, Oneonta, Ringwood in Tompkins Co., and Saranac Lake); NOVA SCOTIA (Baddeck); ONTARIO (Jockvale); QUEBEC (Aylmer, Burbridge, Gracefield, and Knowlton); RHODE ISLAND (Westerly); SASKATCHEWAN (Waskesiu); and WASHINGTON (Westport).

This species occurs in rank shaded herbage and shrubbery in the Canadian and Transitional zones from the Atlantic to the Pacific. In the East, it has not yet been taken south of New York. Adults have been collected as early as May 13 in the Santa Cruz Mts. of California and May 17 in Tompkins Co., N. Y. and as late as Sept. 3 at East River, Conn. The East River specimen was reared by C. R. Ely and bears the label "*Populus tremiloides* edge turner, collected July 13 to Aug. 2., emerged Sept. 3, 1912." A specimen from Orono, Me. was reared July 12, 1913 from *Pristiphora sycophanta*.

2. **Polyblastus (Labroctonus) jugatus,** new species

Pronotum largely ferruginous; scutellum black; second tergite black, margined with dusky ferruginous.

Fore wing 5.3 mm. long; as seen from above, temple 0.64 as long as the eye; lower half of mesopleurum with weak and rather sparse punctures; mesopleurum just below tegula with a rounded longitudinal ridge; pectination of tarsal claws long and rather dense, the apical teeth not projecting as far as the subbasal ones and the apical pecten tooth separated from the apical tooth of the claw so that there is a conspicuous gap between the pecten and the claw tip; body build medium.

Black. Clypeus, mandible except apex, palpi, hind corner of pronotum, tegula, wing bases, and all but the apical 0.18 of hind tibia

whitish yellow; scape and pedicel dusky ferruginous beneath; propleurum castaneous, margined with dusky ferruginous; pronotum dark ferruginous, its dorso-anterior part with an ill-defined castaneous area; mesepimeron dark ferruginous; apical 0.5 of propodeum dark ferruginous, the ferruginous part not sharply defined; front and middle legs and hind legs basad of tibiae ferruginous, their trochanters slightly paler; apical 0.18 of hind tibia fuscous, its tibial spurs whitish; hind tarsus fuscous, the segments pale basally; apical margins of first three tergites and extreme bases of second and third tergites dusky ferruginous, the fourth and following tergites very narrowly margined with ferruginous.

Type: ♂, Pinkham Notch, N. H., June 25, 1938, H. & M. Townes (Townes).

3. **Polyblastus (Labroctonus) bimacula,** new species

Abdomen largely ferruginous; thorax black; lateral margin of posterior part of mesoscutum not produced as a conspicuous flange.

Fore wing 5.6 mm. long; as seen from above, the temple about 0.65 as long as the eye; lower half of mesopleurum with well separated punctures; mesopleurum just below the tegula produced upwards as a thin sharp-edged flange whose upper margin almost reaches the tegula (as in *alatus*, fig. 2); pectination of tarsal claws dense, the apical teeth not projecting as far as the subbasal ones and the pecten not quite reaching the apical tooth of the claw, so that there is a conspicuous gap between the pecten and the apical tooth of the claw; body build medium.

Black with the abdomen beyond the first tergite mostly ferruginous. Clypeus, mandible except its apex, usually the cheek, palpi, under side of scape, hind corner of pronotum, tegula, wing bases, front and middle coxae, trochanters, and all but the apical 0.2± of hind tibia whitish yellow. The fore and middle coxae are often more or less ferruginous, especially towards their bases, and the base of the hind tibia as often ferruginous or somewhat infuscate. Pedicel and upper side of scape dusky ferruginous to pale yellow; front and middle legs beyond the trochanters and hind coxa and femur ferruginous; apical 0.2± of hind tibia fuscous, its tibial spurs whitish; hind tarsus fuscous, the bases of the segments paler; median part of apical margin of first tergite ferruginous; second and following tergites entirely ferruginous except that there are usually a pair of ill-defined brownish triangles with inward pointed apices on each of the second and third tergites and that the abdomen may be darkened apically and laterally, especially in males.

Paratypes: ♂, Bilby, Alta., June 14, 1924, G. Salt (Edmonton). ♂, Bilby, Alta., July 4, 1924, O. Bryant (Edmonton). 2 ♀, Wabamun, Alta., July 4 and 5, 1940, E. H. Strickland (Edmonton). ♀, Cultus Lake, B. C., Oct. 22, 1938, J. K. Jacobs (Ottawa). 2 ♂, Casco, Me., Aug. 1 to 2 and Aug. 11, 1944, J. C. Bradley (Ithaca). ♂, Takoma Park, Md., Aug. 16, 1942, H. & M. Townes (Townes). ♀, Chester, Mass., Aug. 5, 1911 (Cambridge). ♀, Makinac Island, Mich., C. H. Kennedy (Columbus). 2 ♀, Randolph, N. H., July 4 and 7, 1946, M. Townes and J. Peck (Townes). ♂, Oneonta, N. Y., Aug. 31, 1935

H. Townes (Townes). 2 ♀, Pisgah Mt. at 5000 to 5749 ft., N. C., Sept. 5, 1939, H. & M. Townes (Townes). ♀, Stoneham, Que., June 21, 1938, H. & M. Townes (Townes). ♀, Westerly, R. I., June 12, 1937, H. & M. Townes (Townes). ♀, Waskesiu Lake, Sask., July 31, 1939, A. B. Brooks (Ottawa). ♀, Falls Church, Va., June 4, N. Banks (Cambridge). 2 ♂, 8 ♀, Ashford, Wash., July 10, 1940, July 27, 1940, Aug. 18, 1940, and Aug. 19, 1940, H. & M. Townes (Townes). ♀, Barnes State Park, Wash., Aug. 12, 1940, H. & M. Townes (Townes). ♀, Elbe, Wash., July 25, 1940, H. & M. Townes (Townes). 4 ♂, 4 ♀, Mt. Rainier at 2700 ft., 2900 ft., 4000 ft., and 4200 ft., collected in 1940 on July 7, 8, and 15, and Aug. 13, and 14, H. & M. Townes (Townes). ♂, no locality, Aug. 1, 1894 (Ottawa). ♀, no data (Ithaca).

This species occurs in the rank vegetation of moist woods in the Transitional and Canadian zones from the Atlantic to the Pacific. Adults have been taken from June 12 at Westerly, R. I. to October 22 at Cultus Lake, B. C.

4. **Polyblastus (Labroctonus) rutilus,** new species

Thorax entirely ferruginous.

Fore wing about 5.7 mm. long; as seen from above, the temple about 0.77 as long as the eye; lower half of mesopleurum with well separated punctures; mesopleurum just beneath the tegula produced upwards as a thin sharp-edged flange whose upper margin almost reaches the tegula (as in *P. alatus*, fig. 2); pectination of tarsal claws dense, the apical teeth not projecting as far as the subbasal ones and the pecten not quite reaching the apical tooth of the claw, so that there is a conspicuous gap between the pecten and the apical tooth of the claw; body build medium.

Light ferruginous with the head black. Clypeus, mouth parts, hind corner of pronotum, tegula, and trochanters yellow; face ferruginous, somewhat infuscate laterally; region around base of mandible stained with ferruginous; scape and pedicel yellowish in front; flagellum brown; tibiae, tarsi, and tibial spurs stramineous, the hind tibia lightly infuscate on its apical 0.2± and the hind tarsal segments infuscate with their bases pale; ovipositor sheath light brown.

Type: ♀ (lacks flagella), Cazadero, Calif., May 12, 1918, E. P. VanDuzee (San Francisco).

Paratypes: ♂ (abdomen and most of head and thorax missing), Mill Valley, Marin Co., Calif., Mar. 28, 1926 (San Francisco). ♀ (lacks abdomen), Ross, Calif., Apr. 28, 1918, J. C. Bradley (Ithaca).

5. **Polyblastus (Labroctonus) alatus,** new species

Figure 2

Lateral margin of hind part of mesoscutum produced upwards as a flange that is about 0.8 as wide as the tegula.

Fore wing 5.5 mm. long; as seen from above, the temple about 0.73 as long as the eye; lower half of mesopleurum with well separated punctures; mesopleurum just beneath the tegula produced upwards as a thin sharp-edged flange whose upper margin almost reaches the tegula

(fig. 2); lateral margin of hind part of mesoscutum produced as an upcurved thin flange that is about 0.8 as wide as the tegula (this is present in other members of the genus but in these it is not more than about 0.3 as wide as the tegula and is more like a carina than a flange); pectination of tarsal claws dense, the apical teeth not projecting as far as the subbasal ones and the pecten not quite reaching the apical tooth of the claw, so that there is a conspicuous gap between the pecten and the apical tooth of the claw; body build medium.

Colored as in *bimacula*, but the cheek always black.

Type: ♀, on Northwest Branch at University Lane bridge, Takoma Park, Md., June 14, 1942, H., M., & G. Townes (Townes).

Paratypes: 2 ♂, Georgetown, D. C., H. H. Smith (Washington). 2 ♂, ♀, Cabin John, Md., collected June 1912, June 1917, and Sept. 1915 by R. M. Fouts (Washington). ♀, Cabin John, Md., June 14, S. A. Rohwer (Washington). ♀, Cabin John Bridge, Md., R. M. Fouts (Washington). ♀, Cabin John Bridge, Md., (Washington). ♂, ♀, on Northwest Branch at University Lane bridge, Takoma Park, Md., June 7 and June 21, 1942, H. & M. Townes (Townes). ♀, Takoma Park, Md., Sept. 12, 1942, H. & M. Townes (Townes). ♂, 3 ♀, Poughkeepsie, N. Y., collected July 15, July 23, July 24, and Aug. 2, 1936 by H. Townes (Townes). ♂, Mt. Holly Springs, Pa., July 7, 1918, R. M. Fouts (Washington). ♀, Mt. Holly Springs, Pa., Sept. 1, 1918, R. M. Fouts (Washington). 2 ♀, Falls Church, Va., June 28, 1918, R. A. Cushman (Washington). ♀, Great Falls, Va., July 21 (Cambridge). 2 ♂, 4 ♀, Rosslyn, Va., H. H. Smith (Washington).

This species occurs in the rank vegetation of moist woods in the southern part of the Transitional Zone from New York to Virginia. Adults have been taken at Takoma Park, Md. from June 7 to September 12, most of them in June and July.

6. **Polyblastus (Labroctonus) productus,** new species

Edge of claw pecten straight; thorax black; scape yellow in front; cheek black; combined areola and basal area longer than the petiolar area.

Fore wing about 6.0 mm. long; as seen from above, the temple about 0.67 as long as the eye; lower half of mesopleurum with well separated punctures; mesopleurum just below the tegula with a rounded longitudinal ridge; pectination of tarsal claws even, long, and dense, with no gap between the last pecten tooth and the apical tooth of the claw; body build rather slender, the propodeum slightly longer and flatter than usual, with the combined areola and basal area usually longer than the petiolar area.

Black. Clypeus, mandible except its apex, palpi, under side of scape and pedicel, posterior corner of pronotum, tegula, wing bases, trochanters, front and middle coxae, and all except the apical 0.18± and often the basal 0.1± of the hind tibia whitish yellow; front and middle legs beyond the trochanters and hind femur ferruginous or sometimes castaneous, in which case it is darkest above; hind coxa ferruginous, usually infuscate dorsally; apical 0.18± of hind tibia infuscate, its tibial spurs whitish; hind tarsus blackish, the segments paler at the base,

the first segment most broadly so; basal 0.1± of the hind tibia sometimes distinctly infuscate; apical margins of abdominal tergites and basal margins of second and third tergites ochraceous.

Type: ♀, Round Pass, 4000 ft., Mt. Rainier, Wash., Aug. 14, 1940, H. & M. Townes (Townes).

Paratypes: 5 ♀, collected with the type, and ♀, Lake George, 4200 ft., Mt. Rainier, Wash., July 15, 1940, H. & M. Townes (Townes).

In addition to the paratypes there is a male collected at Fish Creek, 2900 ft., Mt. Rainier, Wash., August 14, 1940 by H. & M. Townes (Townes) which is slightly larger and stouter than the type and paratypes and has the hind femur almost entirely castaneous.

All specimens were taken in Canadian coniferous woods among shoulder-high *Vaccinium* and other ericaceous shrubs. There appears to be a peak of abundance around the middle of August as, except for a single specimen, none were seen in visits on July 7, 12, 15, and 28, 1940 to the same areas which yielded the specimens listed above.

7. **Polyblastus (Labroctonus) gloriosus** Davis, new combination

Phaestus gloriosus Davis, 1898. Trans. Amer. Ent. Soc. 24: 292. Type: ♀, Wash. (Philadelphia).

Thorax largely ferruginous; scutellum ferruginous; second tergite black, marked with whitish.

Fore wing about 5.0 mm. long; as seen from above, the temple about 0.70 as long as the eye; lower half of mesopleurum with well separated punctures; mesopleurum just below the tegula with a rounded longitudinal ridge; pectination of tarsal claws even, long, and dense, with no gap between the last pecten tooth and the apical tooth of the claw; body build medium.

Black, the thorax partly ferruginous. Clypeus, malar space, mandible except its apex, palpi, under side of scape and pedicel, posterior corner of pronotum, tegula, wing bases, coxae, trochanters, and all except apical 0.15± of hind tibia yellowish white; upper side of scape brownish ferruginous to yellowish; propleurum, mesoscutum except often for a median dark stripe, scutellum, and anterior part of mesopleurum ferruginous; front and middle legs beyond trochanters and hind femur ferruginous, the femur somewhat infuscate at the apex; apical 0.15± of hind tibia fuscous, the hind tibial spurs whitish; hind tarsus fuscous, pale at the bases of the segments, more broadly so at the base of the first segment; basal 0.1± of hind tibia often infuscate; tergites with a stramineous to buff apical margin, the second to fourth tergites with a basal margin of the same color. The basal and apical pale margins of the second to fourth tergites are widened medially, often, especially in females, widened to such an extent that the pale of the basal and apical margins meet to form a median longitudinal pale band and the black color is reduced to two lateral areas.

Specimens: 4 ♂, Crescent City, Calif., Aug. 2 and 3, 1940, H. & M. Townes (Townes). ♂, ♀, Cannon Beach, Oreg., Aug. 11, 1940, H. & M. Townes (Townes). ♀, Warrenton, Oreg., Aug. 8, 1940, H. & M. Townes (Townes). ♀, Cascapedia, Que., Aug. 15, 1933, W. J.

Brown (Ottawa). 2 ♂, Ashford, Wash., Aug. 18, 1940, H. & M. Townes (Townes). 2 ♂, ♀, Westport, Wash., July 17, 1940, H. & M. Townes (Washington and Townes).

This species occurs in rank herbage and shrubbery.

8. **Polyblastus (Labroctonus) galaphilus,** new species

Edge of claw pecten straight; thorax black; scape yellow in front; cheek usually white; combined basal area and areola shorter than the petiolar area.

Fore wing about 5.5 mm. long; as seen from above, the temple about 0.62 as long as the eye in the male and about 0.70 as long as the eye in the female; lower half of mesopleurum with well separated punctures; mesopleurum just below the tegula with a rounded longitudinal ridge; pectination of tarsal claws even, long, and dense, with no gap between the last pecten tooth and the apical tooth of the claw; body build medium; upper bulla of second recurrent vein separated from cubitus usually by more than half its length (this bulla in other species is usually slightly closer to the cubital vein).

Black. Clypeus, usually the cheek, mandible except its apex, palpi, under side of scape and pedicel, trochanters, fore and middle coxae, hind corner of pronotum, tegula, wing bases, hind tibia except for its infuscate base and apex, apical margin of tergites and basal margin of second and third tergites whitish yellow; front and middle legs beyond trochanters, hind coxa, and hind femur ferruginous; basal 0.1± of hind tibia weakly infuscate, the apical 0.18± strongly infuscate; hind tibial spurs whitish; hind tarsus fuscous, the first segment pale at the base and the rest of the segments pale at the extreme base.

Type: ♀, collected in woodland west just across highway from the railway station at Ashford, Wash., July 26, 1940, H. & M. Townes (Townes).

Paratypes: ♀, Banff at 4600 ft., Alta., Aug. 16, 1924 G. Salt (Washington). ♂, Edmonton, Alta., June 5, 1924, Owen Bryant (Townes). ♀, Northeast Harbor, Maine, Aug. 10, 1911, C. W. Johnson (Washington). ♂, Randolph, N. H., July 4, 1946, M. Townes and J. Peck (Townes). ♂, Cranberry Lake, N. Y., June 21, 1925 (Washington). ♂, ♀, Meacham, Oreg., Aug. 20, 1940, H. & M. Townes (Townes). ♀, Hull, Que., May 31, 1903 (Ottawa). ♀, Waskesiu, Sask., June 25, 1938, J. G. Rempel (Townes). ♀, collected with the type (Townes). 2 ♀, Ashford, Wash., Aug. 18, 1940, H. & M. Townes (Townes). ♀, Elbe, Wash., July 25, 1940, H. & M. Townes (Townes).

This species occurs in the rank undergrowth of moist woods in the Transitional and Canadian zones from the Atlantic to the Pacific. It has not been taken south of New York in the East nor of Oregon in the West. Adults have been taken from May 31 to August 20.

9. **Polyblastus (Labroctonus) stenocentrus** Holmgren, new combination

Polyblastus stenocentrus Holmgren, 1855. Svenska Vet.-Akad. Handl. 1: 215. Types: ♂, ♀, Sweden (? Stockholm).

Hind coxa blackish; hind femur ferruginous.

Fore wing about 6.2 mm. long; temple swollen, as seen from above about 0.90 as long as the eye; lower half of mesopleurum with well sepa-

rated punctures; mesopleurum just below the tegula with a rounded longitudinal ridge; pectination of tarsal claws even, long, and dense, the pecten not extending quite the full length of the claw so that there is a very small gap between its end and the apical tooth of the claw; body build medium.

Black. Clypeus, mandible except apex, palpi, tegula, and wing bases pale yellowish; scape dusky ferruginous below; legs ferruginous, the trochanters paler; hind coxa black; front and middle coxae blackish basally; hind tibia pale ferruginous, the basal 0.12± slightly infuscate and the apical 0.2± infuscate; hind tibial spurs pale ferruginous; hind tarsus blackish, the first segment pale basally and the rest of the segments pale at the extreme base; apical margin of tergites and extreme basal margin of second and third tergites buff.

Specimens: ♂, 2 ♀, Mt. McKinley National Park, Alaska, 1932, F. W. Morand (Washington and Townes).

These specimens have been compared with a European female determined by Pfankuch. In view of the difficulty of distinguishing species in this group, it is not certain that the European and American specimens really represent the same species nor that Pfankuch's determination is correct. However, we find no valid grounds for describing the American specimens as representing a new species. In the Palaearctic region, *stenocentrus* is reported from northern Europe and Kamchatka.

10. **Polyblastus (Labroctonus) peckae,** new species

Hind femur black; tergites without a conspicuous pale hind margin.

Type female: Fore wing 6.7 mm. long; temples swollen, as seen from above 0.93 as long as the eye; lower half of mesopleurum with well separated punctures; mesopleurum just below the tegula with a rounded longitudinal ridge; pectination of tarsal claws even, long, and dense, with no gap between the end of the pecten and the apical tooth of the claw; body build medium.

Black. Clypeus, basal 0.6 of mandible, posterior corner of pronotum, and tegula yellow; apical part of mandible red-brown shading to dark brown at the tip; palpi stramineous; under side of scape with a reddish stain; legs light red, the apical half of the fore and middle coxae, trochanters except the hind ones posteriorly, and a small spot on the apex of the front femur yellow; hind coxa and femur black, the femur reddish at the base; hind tibia stramineous with the apical 0.25 blackish; hind tarsal segments blackish, pale at the base; ovipositor sheath dark brown.

Type: ♀, Randolph, N. H., July 2, 1946, M. Townes and J. Peck (Townes).

11. **Polyblastus (Labroctonus) articulatus** Cresson, new combination

Tryphon articulatus Cresson, 1868. Trans. Amer. Ent. Soc. 2: 110. Type: ♀, Hudson Bay Territory (Philadelphia).

Hind femur castaneous; tergites margined with whitish.

Fore wing about 5.3 mm. long; temple rather swollen, as seen from above about 0.90 as long as the eye; lower half of mesopleurum with well separated punctures; mesopleurum just below tegula with a rounded longitudinal ridge; pectination of tarsal claws even, long, and dense,

with no gap between the end of the pecten and the apical tooth of the claw; body build medium.

Colored as is *Polyblastus stenocentrus* except that the hind femur is castaneous.

Specimens: ♀, Lake Louise, Alta., July 29, 1938, G. S. Walley (Townes). ♂, Churchill, Man., July 24, 1937, W. J. Brown (Ottawa). ♀, Churchill, Man., July 31, 1937, W. J. Brown (Ottawa). ♀, Churchill, Man., Aug. 2 to 9, 1937, D. G. Denning (St. Paul).

12. **Polyblastus (Labroctonus) buccatus,** new species

Scape black, indistinctly ferruginous in front; hind coxa mostly or entirely ferruginous; thorax black.

Fore wing about 5.5 mm. long; temple strongly swollen, as seen from above about 0.87 as long as the eye in the male and about 1.1 as long as the eye in the female; lower half of mesopleurum with well separated punctures; mesopleurum just below tegula with a rounded longitudinal ridge; pectination of tarsal claws even, long, and dense, with no gap between the last pecten tooth and the apical tooth of the tarsal claw; body build slightly stouter than usual.

Black. Clypeus, posterior corner of pronotum, tegula, and wing bases whitish yellow; mandible whitish yellow, its apical part pale ferruginous tipped with castaneous; palpi pale ferruginous; under side of scape dusky ferruginous; legs ferruginous, the hind tibia with the apical 0.18± infuscate and sometimes slightly infuscate towards the base; hind tarsus fuscous, dusky ferruginous at the bases of the segments. The hind coxa of the male is ferruginous but somewhat infuscate on its basal two-thirds. In the female the hind coxa is uniformly ferruginous. Apical margins of tergites brown, the margins palest and broadest on the second and third segments.

Type: ♀, Paradise Valley, where highway crosses Edith Creek at 4700 ft., Mt. Rainier, Wash., July 11, 1940, H. & M. Townes (Townes).

Paratypes: 2 ♂, ♀, collected with the type (Townes). ♂, Mt. Rainier at 5000 ft., Wash., July 9, 1940, H. & M. Townes (Townes). ♀, Mt. Rainier at 5300 ft., Wash., Aug. 15, 1940, H. & M. Townes (Townes).

The above specimens were all collected at timberline where scattered groups of conifers are interspersed with mountain meadows.

13. **Polyblastus (Labroctonus) expletus,** new species

Second tergite ferruginous; thorax black and ferruginous.

Fore wing about 7.3 mm. long; as seen from above, the temple about 0.63 as long as the eye in the male and about 0.92 as long as the eye in the female; lower part of mesopleurum with moderately dense punctures (usually distinctly more strongly and closely punctate than in other members of the subgenus); mesopleurum just below the tegula with a rounded longitudinal ridge; pectination of tarsal claws even, moderately long, and dense, with no gap between the last pecten tooth and the apical tooth of the claw; ovipositor sheath about 3.8 as long as broad (about 4.5 as long as broad in all other members of the subgenus); body build more robust than in other members of the subgenus.

Black, the thorax and abdomen partly ferruginous. Clypeus, mandible except apex, palpi, tegula, and wing bases and sometimes the cheek pale yellowish; sometimes the face marked medially with yellow or ferruginous; scape and pedicel more or less ferruginous in front; thorax black, with more or less extensive ferruginous areas covering some or all of the pronotum, scutellum, and propodeum. Sometimes all the thorax except the mesosternum and lower three-fourths of the mesopleurum are ferruginous. Legs ferruginous, the tibiae somewhat paler; apical 0.1± of hind tibia infuscate; hind tarsus infuscate, darkest towards the apices of the segments; abdomen ferruginous, the fourth and following tergites black; third tergite black laterally and sometimes entirely black except for its base; first tergite usually with ill-defined dark markings, especially towards its base.

Type: ♀, Bemus Point, N. Y., July 25, 1937, H. Townes (Townes).

Paratypes: ♀, Nain, Labrador, Aug. 17, 1908, Owen Bryant (Washington). ♂, Bar Harbor, Me., Aug. 23, 1938, A. E. Brower (Townes). ♀, Casco, Me., Aug. 9, 1944, J. C. Bradley (Townes). ♂, Laurel Lake, Jacksonville, Vt., July 30, 1939, H. D. Pratt (St. Paul). ♀, Gould, Compton Co., Que., reared in 1941 from *Pteronidea limbata* (Ottawa).

Genus **Ctenochira**[3]

Figures 6 to 11

Ctenochira Foerster, 1855. Verh. Naturh. Ver. Preuss. Rheinlande 12: 226. Type: *Ctenochira bisinuata* Foerster. Monobasic.

Ctenacme Foerster, 1868. Verh. Naturh. Ver. Preuss. Rheinlande 25: 196. New synonymy. Type: *Polyblastus scutellatus* Thomson (=*scutellaris* Thomson). Designated by Morley 1913.

Scopiorus Foerster, 1868. Verh. Naturh. Ver. Preuss. Rheinlande 25: 196. New synonymy. Type: *Polyblastus marginatus* Holmgren. Designated by Viereck 1914.

Gemophaga Foerster, 1868. Verh. Naturh. Ver. Preuss. Rheinlande 25: 211. Type: *Gemophaga rufa* Ashmead. Included by Ashmead 1902.

Ctenacmus Thomson, 1883. Opusc. Ent. 9: 901. New synonymy. Type: *Polyblastus* (*Ctenacmus*) *genalis* Thomson. Designated by Viereck 1914, when he listed this species as the type of *Ctenacme* Foerster and *Ctenacmus* Thomson as an emendation of *Ctenacme*.

Trichocalymmus Thomson, 1883. Opusc. Ent. 9: 903. New synonymy. Type: *Tryphon propinquus* Gravenhorst. Designated by Viereck 1914.

Exochoblastus Schmiedeknecht, 1912. Opusc. Ichneum. fasc. 30: 2401; fasc. 31: 2468. New synonymy. Type: *Exochoblastus oreophilus* Schmiedeknecht. Monobasic.

Scopimenus Roman, 1937. Ent. Mo. Mag. 74: 64. New synonymy. Type: *Scopimenus pygobarbus* Roman. Monobasic.

Ovipositor sheath broad, with a dorsal apical emargination; clypeus relatively narrow; second tergite usually with a broad, shallow, transverse groove.

Fore wing 4.0 to 7.5 mm. long; body short and stout; clypeus oval, evenly convex or with a weak subapical transverse impression, its apical margin without a fringe of setae; clypeal foveae rarely enlarged and filled with long setae; cheek 0.25 to 0.65 the basal width of the mandible; posterior mandibular condyles not as far apart as are the

[3]We are indebted to Mr. J. F. Perkins for calling our attention to the proper application of the name *Ctenochira*. Foerster's detailed original description leaves no doubt of the genus he had before him.

eyes at the level of the clypeal foveae; female flagellum with areas of sensory setae occupying the under side of the median segments; outer face of mandible at its basal 0.2 strongly convex, with a few weak punctures; postero-lateral corner of pronotum not unusually heavy nor projecting; subtegular ridge unspecialized, or in *C. subcrassa* rather strongly projecting and containing a deep slot (fig. 11); tegula convex; female with mesosternum and under side of fore and middle coxae with a brush of long suberect silky hairs (this absent in other genera of the tribe); areolet present or absent, when present oblique; second recurrent vein evenly curved, with two well separated bullae; nervellus broken at its lower 0.2 to 0.4; tarsal claws pectinate nearly or quite to the apex; second tergite usually with a postmedian, broad, shallow, transverse groove, usually more or less rugulose and mat, and often more or less punctate; female subgenital plate with rather long, erect or suberect pubescence; ovipositor sheath broad, with an apical dorsal emargination extending 0.2 to 0.7 its length, not flexible except at the base (figs. 6 to 10); ovipositor decurved, evenly tapered to a slender point, about 0.3 as long as the abdomen (fig. 8).

This genus is related to *Polyblastus* and *Erromenus*, as noted under *Polyblastus*.

The species of *Ctenochira* are numerous, variable, and rather closely related. Specimens are scarce in collections, and probably a large per cent of the species are yet to be discovered. Besides those treated, some additional species are present in the material before us but are represented by one or a very few specimens: too few for description in a group as variable as this. Some of the best characters are in the shape and vestiture of the ovipositor sheath, hairs on the female subgenital plate, and the distribution of patches of sensory hairs on the under side of the female flagellum. Their unisexual nature prevents emphasis in the key to species, and the key is constructed largely on "artificial" characters. The species before us seem divisible into three groups.

1. *Subcrassa* group. Second tergite with a postmedian, broad, shallow, transverse impression; ovipositor sheath 1.5 to 2.0 as long as wide, with an apical dorsal emargination extending 0.6 to 0.7 its length (fig. 6); areolet present. Included are the Nearctic *subcrassa*, *debilis*, *tetrica*, and *adeps*.

2. *Propinqua* group. Second tergite with a postmedian, broad, shallow, transverse impression; ovipositor sheath 1.8 to 3.8 as long as wide, with an apical dorsal emargination extending 0.25 to 0.4 its length (figs. 7 to 10); areolet present or absent. The species included are the Nearctic *rufa*, *melina*, *analis*, *gagates*, *gillettei*, *quebecensis*, *inflata*, *potens*, *pectoralis*, *pikonematis*, *infans*, *extricata*, *dilatata*, *rubicunda*, *ferrugata*, *picta*, and *frigida*, and the Palaearctic *Tryphon propinquus* Gravenhorst 1829, *Polyblastus rivalis* Holmgren 1855, and *Exochoblastus oreophilus* Schmiedeknecht 1912. *Oreophila* is the type of *Exochoblastus*. A female specimen that has been studied represents nothing more than an aberrant species of this group, with the cheek very short (about 0.25 as long as the basal width of the mandible), the face rather protuberant, the pecten teeth of the tarsal claws very short, the areolet unusually large, and the body unusually short and stout.

Probably the majority of the Palaearctic as well as of the Nearctic

species belong to the ***propinqua*** group, but the only Palaearctic species examined are those mentioned above.

3. ***Pygobarbus*** group. Second tergite without a transverse impression; ovipositor sheath about 1.1 to 1.3 as long as wide, with an apical dorsal emargination extending about 0.3 its length; areolet absent; abdomen rather elongate. Included are the Nearctic *deplanata* and the Palaearctic *Scopimenus pygobarbus* Roman 1937.

KEY TO THE AMERICAN SPECIES OF CTENOCHIRA

1. Flagellum with a broad median white band.....2
   Flagellum entirely dark.....3
2. Body largely ferruginous; hind tibia stramineous, blackish apically and subbasally.....20. **picta**
   Body entirely black, hind tibia entirely blackish.....6. **melina**
3. Subtegular ridge prominent, containing a deep longitudinal slot in its posterior half (fig. 11); areolet present.....1. **subcrassa**
   Subtegular ridge not containing a slot, but with a deep furrow just below its posterior part.....4
4. Rim of antennal socket laterally about as high as the diameter of the first flagellar segment; face entirely or mostly yellow; costula complete; areolet present.....7. **analis**
   Rim of antennal socket laterally not as high as the diameter of the first flagellar segment; face variously colored, seldom yellow; costula usually incomplete or absent; areolet often absent.....5
5. Metapleurum and third tergite both punctate with moderately coarse punctures; first and second lateral areas of propodeum with a few or many coarse punctures.....6
   Metapleurum and third tergited not both conspicuously punctate; first and second lateral areas of propodeum without distinct punctures.....7
6. Face about 1.80 as wide as long (from lower margin of antennal sockets to clypeal foveae); clothing hairs of ovipositor sheath long, of irregular length, and rather sparse; costula lacking; hind femur ferruginous. 9. **gillettei**
   Face about 1.75 as wide as long; clothing hairs of ovipositor sheath short, of even length, and rather dense; costula often present; hind femur black or ferruginous.....8. **gagates**
7. Second tergite without a postmedian transverse groove; mesoscutum except at the margin very sparsely and finely punctate; body depressed; face yellow.....22. **deplanata**
   Second tergite with a postmedian weak transverse groove; mesoscutum with distinct, moderately dense punctures; body not depressed; face variously colored.....8
8. Second tergite black, often with a narrow pale apical margin.....9
   Second tergite entirely or mostly ferruginous (*infans* runs in either half of this couplet).....16
9. Front of scape and more or less of the face white or pale yellow.....10
   Front of scape black to light brown; face black, sometimes with the lower lateral corners white.....12
10. Face with its white markings more or less interrupted or reduced by black vertical lines or areas; metapleurum of male black; female with second segment of middle tarsus longer than wide.....14. **pikonematis**
    Face whitish all of the way across; metapleurum of male ferruginous; female with second segment of middle tarsus wider than long.....11
11. Female flagellum with ventral sensory areas beginning on the second segment, its fifth segment about 1.2 as long as wide; second tergite not rugulose, strongly and uniformly mat.....11. **inflata**
    Female flagellum with ventral sensory areas beginning weakly on the fourth segment and definitely on the fifth, the fifth segment about 1.9 as long as wide; second tergite usually rugulose, polished to mat.....10. **quebecensis**
12. Second tergite polished, without sculpture; femora black, their apices more or less brown.....3. **tetrica**
    Second tergite punctate, mat, or otherwise sculptured; femora more or less ferruginous.....13

13. Hind tibia with a subbasal blackish band, sometimes also with a broad external blackish stripe so that the subbasal blackish band appears as a broadening of the external stripe; ovipositor sheath about 3.3 as long as wide (fig. 8); epipleurum of fourth tergite of female separated from the tergite by a crease ..... 21. **frigida**
Hind tibia without a subbasal blackish band; ovipositor sheath about 2.2 as long as wide; epipleurum of fourth tergite of female not separated from the tergite by a crease 14
14. Apex of hind tibia not distinctly darkened; hind coxa usually partly or entirely black or piceous; first tergite of female with median carinae on about its basal 0.5 ..... 15. **infans**
Apex of hind tibia more or less distinctly darkened; hind coxa ferruginous; first tergite of female with median carinae on about its basal 0.75 15
15. Tegula white; lower half of thorax of female ferruginous; second segment of middle tarsus of female longer than wide ..... 13. **pectoralis**
Tegula ferruginous to black; thorax of female entirely black; second segment of middle tarsus of female wider than long ..... 12. **potens**
16. Upper margin of ovipositor sheath with an inconspicuous oblique truncation occupying its apical 0.24, the sheath broadly rounded apically (fig. 7); mesoscutum usually ferruginous, or when occasionally black the coxae usually black also; fore wing about 6.0 mm. long; a large robust species, 5. **rufa**
Upper margin of ovipositor sheath with a conspicuous truncation or emargination occupying its apical 0.3 to 0.7, the sheath more or less pointed apically (as in figs. 6, 8, 9, and 10); mesoscutum usually black; coxae ferruginous except in *C. infans*; fore wing about 4.0 to 6.5 mm. long; smaller, more slender species 17
17. Mesoscutum ferruginous 18
Mesoscutum black 19
18. Tegula white; second segment of female middle tarsus about 1.6 as long as wide ..... 18. **rubicunda**
Tegula ferruginous; second segment of female middle tarsus about 2.0 as long as wide ..... 19. **ferrugata**
19. Areolet present in specimens at hand (but presumably sometimes lacking); upper margin of ovipositor sheath with a truncation or emargination occupying about 0.65 its length 20
Areolet absent in specimens at hand (but presumably sometimes present); upper margin of ovipositor sheath with a truncation or emargination occupying 0.3 to 0.4 its length 21
20. Body very stout, the second tergite of the female about 0.45 as long as wide (male unknown); second segment of fore and middle tarsi of female wider than long ..... 4. **adeps**
Body rather slender, the second tergite of the female about 0.56 as long as wide and of the male about 0.63 as long as wide; second segment of fore and middle tarsi of female longer than wide ..... 2. **debilis**
21. Posterior corner of pronotum white; face with at least the lower lateral corners ivory, usually entirely ivory white; temple sloping, in lateral view less than 1.2 as long as the eye 22
Posterior corner of pronotum not white; face black; temple full, in lateral view more than 1.2 as long as the eye 23
22. Apex of hind femur above and of hind tibia distinctly infuscate; face entirely ivory except often for a median dorsal black triangle. East of the Rocky Mountains ..... 17a. **dilatata dilatata**
Apex of hind femur not infuscate; apex of the hind tibia not or slightly infuscate; face white with a median vertical dark stripe, to black with the lower lateral corners white. West of the Rocky Mountains, 17b. **dilatata niveicola**
23. Abdomen entirely ferruginous; hairs on median part of female subgenital plate suberect, sloping slightly backwards; first tergite of female with the median dorsal carinae ending at about its apical 0.8 ..... 16. **extricata**
Abdomen largely black; hairs on median part of female subgenital plate sloping slightly forward; first tergite of female with the median dorsal carinae ending at about its middle ..... 15. **infans**

1. **Ctenochira subcrassa** Cresson, new combination

Figures 6 and 11

Tryphon subcrassus Cresson, 1868. Trans. Amer. Ent. Soc. 2: 109. Type: ♀, Mass. (Philadelphia).

Subtegular ridge with a deep longitudinal slot in its posterior half.

Fore wing about 5.2 mm. long; face about 1.7 as wide as long, its lateral third with small punctures separated by about 2.0 their diameter; fifth flagellar segment of male (as seen from below) about 1.9 as long as wide, of female about 2.2 as long as wide; female flagellum with ventral sensory areas beginning on fourth segment; mesopleurum and metapleurum with small punctures separated by about 4.0 their diameter; subtegular ridge (fig. 11) more prominent than in other species of the genus, its posterior half with a deep longitudinal slot (this absent in other species of the genus); dorsal part of propodeum polished, smooth to somewhat rugulose, impunctate; combined areola and basal area about 1.1 as long as the petiolar area; costula strong to weak or incomplete; areolet present; second segment of middle tarsus about 2.0 as long as wide in the male and 1.25 as long as wide in the female; second tergite of male about 0.65 as long as wide, polished, strongly longitudinally rugulose and weakly mat on the basal 0.8; second tergite of female about 0.56 as long as wide, polished, the basal 0.5 medially weakly rugulose and mat; epipleurum of fourth segment separated from the tergite by a weak fold in the male, not separated in the female; pubescence on female subgenital plate short, dense, sloping slightly backwards; ovipositor sheath about 1.5 as long as wide, its apical dorsal emargination extending about 0.6 its length (fig. 6), its clothing hair rather dense, of moderate length, the hair bases separated by about 0.3 the length of the hairs.

Black. Basal half of mandible and tegula white; clypeus except on its basal 0.2 stramineous; apical half of mandible, palpi, and legs ferruginous, the hind tarsi, hind tibia apically, sometimes the hind tibia largely, and sometimes the hind femur apically above infuscate; pedicel externally and often the scape externally more or less pale; flagellum red brown beneath, darker above; hind corner of pronotum dark ferruginous; abdomen ferruginous, the fifth and following tergites black; first tergite infuscate basally in the female, more extensively blackish in the male; fourth, third, and rarely the second tergite of the male sometimes more or less blackish; ovipositor sheath and male claspers blackish.

Specimens: ♂, Bilby, Alta., July 14, 1924, O. Bryant (Townes); ♂, Smithers, B. C., July 4, 1924, E. R. Buckell (Ottawa). 2 ♀, Martha's Vineyard, Mass., Aug. 5 and 28, F. M. Jones(Townes). ♀, Moorestown, N. J., July 12, 1939, H. & M. Townes (Townes). ♀, Greenport, N. Y., (Washington). ♂, Otsego Lake, N. Y., June 28, 1935, H. Townes (Townes). ♂, 32 miles east of Pineville, Ore., July 22, 1935, Joe Schuh (Corvallis).

2. **Ctenochira debilis,** new species

Areolet present; second tergite not punctate; face and thorax black; hind tibia uniformly ferruginous; subtegular ridge not containing a longitudinal slot.

Fore wing about 5.0 mm. long; face about 1.4 as wide as long, its lateral third with small to medium sized punctures separated by 2.0 to 1.2 their diameter; fifth flagellar segment of male (as seen from below) about 1.9 as long as wide, of female about 2.3 as long as wide; female flagellum with ventral sensory areas beginning on the fifth segment; mesopleurum with very small to moderately small punctures separated by about 3.5 their diameter; metapleurum not distinctly punctate; dorsal part of propodeum polished, weakly rugulose, impunctate; combined basal area and areola about 1.4 as long as the petiolar area; costula strong to weak or incomplete; areolet present; second segment of middle tarsus about 2.2 as long as wide in the male and 1.5 as long as wide in the female; second tergite of male about 0.63 as long as wide, polished, the basal 0.75 distinctly rugulose; second tergite of female about 0.56 as long as wide, polished, the basal 0.75 indistinctly rugulose; epipleurum of fourth segment of male separated from the tergite by a weak fold, of the female not separated; pubescence on female subgenital plate short, dense, sloping slightly backwards; ovipositor sheath about 1.75 as long as wide, its apical dorsal emargination extending about 0.6 its length, its clothing hair rather dense, of moderate length, the hair bases separated by about 0.3 the length of the hairs.

Black. Tegula and basal half of mandible whitish; clypeus except its basal 0.2 stramineous; apical half of mandible, palpi, extreme hind corner of pronotum, legs, abdomen except for the basal 0.5± of first segment, ovipositor sheath, and male clasper ferruginous, the hind tibia quite uniformly ferruginous; under side of female flagellum red-brown. Sometimes the hind coxa basally and the abdominal tergites, especially beyond the third tergite, are more or less infuscate. The ovipositor sheath of the paratype female is blackish.

Type: ♀, among forest underbrush at Round Pass, Mt. Rainier, Wash., 3800 ft., July 7, 1940, H. & M. Townes (Townes).

Paratypes: ♂, Laggan, Alta., Aug. 26, 1925, O. Bryant (Washington). ♂, Cameron Pass, Colo., Aug. 19, 1940, C. E. Mickel (St. Paul). ♀, Missoula, Mont., July 6, 1917, H. G. Dyar (Townes). ♂, Mt. Rainier, Wash., 2900 ft., July 7, 1940, H. & M. Townes (Townes). ♂, Mt. Rainier, Wash., 5300 ft., Aug. 16, 1940, H. & M. Townes (Townes). ♂, collected with the type (Townes).

3. **Ctenochira tetrica,** new species

Body black; femora black with brownish apices; second tergite polished, without sculpture.

Female type: Fore wing 5.0 mm. long; face 1.8 as wide as long, its lateral third with fine punctures separated by about 2.0 their diameter; fifth flagellar segment (as seen from below) 1.7 as long as wide; sensory areas beginning on the apical half of the third flagellar segment; mesopleurum with small punctures separated by about 3.0 their diameter; metapleurum impunctate; dorsal part of propodeum polished, impunctate; combined basal area and areola 1.3 as long as the petiolar area; costula absent; areolet present; second segment of middle tarsus 1.8 as long as wide; second tergite 0.60 as long as wide, polished, without sculpture, its postmedian transverse furrow very weak; epipleurum of fourth segment not separated from its tergite by a fold; pubescence of subgenital plate short, dense, sloping slightly backwards; ovipositor

sheath 2.3 as long as wide, its apical dorsal emargination extending 0.67 its length, its clothing hairs rather dense, of moderate length, their sockets separated by about 0.3 the length of the hairs.

Black. Clypeus except on its basal 0.25, mandible except basally, palpi, anterior 0.35 of tegula, broad apex of front femur, narrow apices of middle and hind femora, tibiae, tarsi, subgenital plate, and ovipositor sheath brown; apical 0.65 of tegula white.

Type: ♀, Trail Ridge Road, Rocky Mt. National Park, Colo., 12,200 ft., Aug. 25, 1933, M. & H. James (Townes).

4. **Ctenochira adeps,** new species

Areolet present; second segment of female abdomen about 0.45 as long as wide; apical dorsal emargination of ovipositor sheath extending about 0.7 its length; subtegular ridge not containing a deep longitudinal slot.

Female type: Fore wing 5.3 mm. long; face 1.6 as wide as long, its lateral third with rather small punctures separated by about 1.5 their diameter; fifth flagellar segment (as seen from below) 1.8 as long as wide; flagellum with ventral sensory areas beginning on the fifth segment; mesopleurum with moderately small punctures separated by about 2.5 their diameter; metapleurum not distinctly punctate; dorsal part of propodeum slightly mat, somewhat rugulose, and with a few indistinct punctures; combined basal area and areola 0.9 as long as the petiolar area; costula complete, rather strong; areolet present; second segment of middle tarsus 0.9 as long as wide; second tergite 0.45 as long as wide, indistinctly mat; epipleurum of fourth segment not separated from the tergite by a fold; pubescence on subgenital plate short, dense, sloping slightly backwards; ovipositor sheath 1.6 as long as wide, its apical dorsal emargination extending 0.7 its length, its clothing hairs rather dense, of moderate length, the hair bases separated by about 0.4 the length of the hairs.

Black. Clypeus, cheek, ventro-lateral corners of face, basal half of mandible, and tegula whitish; apical half of mandible, palpi, legs, and first three tergites ferruginous, the first tergite infuscate basally; posterior corner of pronotum and an indistinct longitudinal stripe on ventral part of mesopleurum dark ferruginous; flagellum brown, blackish above, especially towards the base; ovipositor sheath blackish, vaguely stained with ferruginous.

Type: ♀, Stewart Park, Ithaca, N. Y., May 25, 1939, H. Townes (Townes).

5. **Ctenochira rufa** Ashmead, new combination

Figure 7

Trophoctonus insularis Ashmead, 1902. Proc. Wash. Acad. Sci. 4: 215. Type: ♂, Popof Is., Alaska (Washington).

Gemophaga rufa Ashmead, 1902. Proc. Wash. Acad. Sci. 4: 223. Type: ♂, Popof Is., Alaska (Washington).

Ovipositor sheath short and stout, with an evenly rounded apex, its clothing hairs very dense and short; thorax usually mostly ferruginous, when entirely black the coxae and first trochanters also black.

Fore wing about 6.0 mm. long; face about 1.75 as wide as long, its lateral third with moderate sized punctures separated by about 1.2 their diameter; fifth flagellar segment of male (as seen from below) about 1.8 as long as wide, of female about 1.6 as long as wide; female flagellum with ventral sensory areas beginning on the fourth or fifth segment; mesopleurum with moderate sized punctures separated by about 1.5 their diameter; metapleurum usually impunctate, but sometimes with small punctures; dorsal part of propodeum polished and more or less rugulose, impunctate; combined basal area and areola about 0.9 as long as the petiolar area; costula strong to weak, incomplete, or almost absent; areolet present or absent; second segment of middle tarsus of male about 1.8 as long as wide, of female about 1.1 as long as wide; second tergite about 0.5 as long as wide, strongly mat, the apical 0.15 to 0.2 subpolished, in the male the basal 0.85 somewhat rugulose as well as mat; epipleurum of fourth segment of male separated from the tergite by a fold, of the female not separated; female subgenital plate with erect, rather long, moderately dense pubescence; ovipositor sheath short and stout with an evenly rounded apex, (with a more or less pointed apex in other species), about 1.7 as long as wide and with its apical dorsal emargination extending about 0.24 its length (fig. 7); clothing hairs of ovipositor sheath very dense and short. The figure of the ovipositor sheath is from a dorso-lateral view. From a strictly side view the apical dorsal notch is hardly visible and the end of the sheath almost evenly rounded.

Ferruginous, marked with black to a varying degree. Typically marked with black only on the propleura, thoracic sterna, thorax in the region of the sutures, some of occiput, base of first tergite, and often on the apex of the middle and hind femora above. Apical part of hind tibia often infuscate. Sometimes the black covers all the head but the clypeus, mouthparts, and whitish facial markings, all the thorax including the tegula, the coxae, first trochanters, all but the apex of the first tergite, and apical part of the abdomen. Clypeus except at the base, basal half of mandible, cheek, usually most of the face, and often under side of scape yellowish white. Facial whitish markings sometimes reduced to the ventro-lateral corners. Palpi and flagellum ferruginous to fusco-ferruginous.

Specimens: ♀, Mt. McKinley National Park, Alaska, 1932, F. W. Morand (Townes). ♀, Banff, Alta., June 23, 1922, C. B. D. Garrett (Ottawa). ♀, Elk Creek, Fraser, Grand Co., Colo., July 7 to 9, 1927, J. C. Bradley (Ithaca). ♀, Chambers' Lake, Colo., July 18, 1895, C. F. Baker (Washington). 2 ♀, Fort Collins, Colo., Gillette (Philadelphia, paratypes of *Scopiorus gillettei*); ♂, Arenac Co., Mich., June 3, 1939, R. R. Dreisbach (Townes). ♀, LaPeer Co., Mich., May 30, 1937, R. R. Dreisbach (Townes). ♀, Glen House, N. H. June 11 1916 (Cambridge). ♂, Mt. Marcy, N. Y., July 5, J. N. Belkin (Townes). ♀, Cameron Bay, Great Bear Lake, N. W. T., July 28, 1937, T. N. Freeman (Ottawa). ♀, Sudbury, Ont., June 16, 1892 (Ottawa). ♀, Spring Brook, Pa., May 17, 1945, H. Townes (Townes). ♀, Mt. Rainier, Wash., 4700 ft., July 11, 1904, H. & M. Townes (Townes).

This species is transcontinental in the Hudsonian and Canadian zones.

6. **Ctenochira melina,** new name

Polyblastus annulicornis Provancher, 1886. Addit. Faune Canad. Hymen., p. 108. Preoccupied by Giraud 1871. Type: ♂ (not ♀), Lake Brome, Knowlton, Que. (Quebec).

Flagellum with a median white band; abdomen and hind legs entirely black.

Male: Fore wing 6.0 mm. long; face 1.7 as wide as long, its lateral third with moderate sized punctures separated by about 1.2 their diameter; fifth flagellar segment (as seen from below) 2.1 as long as wide; mesopleurum with medium sized punctures separated by about 2.5 their diameter; metapleurum indistinctly and weakly punctate; dorsal part of propodeum polished, somewhat rugulose, impunctate; combined basal area and areola 0.6 as long as the petiolar area; costula complete, rather strong; areolet present; second segment of middle tarsus 1.6 as long as wide; second tergite 0.55 as long as wide, strongly mat and rugulose, the apical 0.12 smoother and subpolished; epipleurum of fourth segment not separated from the tergite by a fold.

Black. Cheek, ventro-lateral corner of face, and flagellar segments 5 to 11 white; clypeus, mouth parts, and front and middle tarsi brown; front and middle coxae, trochanters, and femora piceous.

Specimen: ♂, Waskesiu, Sask., June 20, 1938, J. G. Rempel (Townes).

7. **Ctenochira analis** Cresson, new combination

Figure 9

Tryphon analis Cresson, 1864. Proc. Ent. Soc. Phila. 3: 279. Type, ♂, Pa. (Philadelphia).

Tryphon occidentalis Cresson, 1868. Trans. Amer. Ent. Soc. 2: 109. Type: ♀, Ill. (Philadelphia).

Face yellow; rim of antennal socket laterally as high as the diameter of the first flagellar segment.

Fore wing about 5.5 mm. long; face about 1.55 as wide as long, its lateral third with medium sized punctures separated by about 1.0 their diameter; rim of antennal socket laterally about as high as the diameter of the first flagellar segment (not so high in other Nearctic species); fifth segment of male flagellum (as seen from below) about 2.1 as long as wide, of female about 2.4 as long as wide; female flagellum with ventral sensory areas beginning on the sixth segment; mesopleurum with medium sized punctures separated by about 2.5 their diameter; metapleurum with indistinct, weak punctures; dorsal part of propodeum polished, weakly rugulose, impunctate; combined basal area and areola about 1.0 as long as the petiolar area; costula complete, usually strong; areolet present; second segment of middle tarsus of male about 1.9 as long as wide, of female about 1.7 as long as wide; second tergite 0.62 as long as wide in the male and about 0.58 as long as wide in the female; second tergite polished, its basal 0.85 punctato-rugulose or rugulose, strongly so in the male and more weakly in the female; epipleurum of fourth segment separated from the tergite by a weak fold in the male and by a very weak fold in the female; female subgenital plate with short dense pubescence that is slanted slightly backwards; ovipositor sheath about 3.0 as long as wide, its apical dorsal emargination extend-

ing about 0.28 its length (fig. 9); clothing hairs of ovipositor sheath dense, the hair bases separated by about 0.3 the length of the hairs.

Black. Face, clypeus, mouth parts except apex of mandible, under side of scape and pedicel, tegula, and trochanters yellow. Face sometimes with a median line, the clypeal groove, and dorsal sublateral triangles brown or black. Usually there are other variable yellow marks, averaging more extensive in the female, as follows: cheek, lower part of temple, lower part to most of propleurum, pro- and mesosterna, and under side of coxae. Legs ferruginous except where yellow (as noted above) and sometimes more or less piceous or infuscate as follows: usually apex of hind femur above, apex of hind tibia and apical part of hind tarsus, rarely the hind femur entirely and the middle femur posteriorly, often more or less of the hind coxa, and occasionally more or less of the middle and fore coxae. Tergites one to four ferruginous, in the female the basal 0.2± of the first tergite blackish, in the male the basal 0.5± of the first tergite and sometimes more or less of the fourth tergite blackish; ovipositor sheath and male clasper blackish.

Two females from Cannon Beach, Oregon, differ from all other specimens in lacking an apical dorsal infuscation on the hind femur, indicating that more material will show the Vancouveran Zone to harbor a distinguishable race.

Specimens: ♂, Bilby, Alta., June 21, 1924, G. Salt (Washington). ♂, Wabamun, Alta., Aug. 2, 1929, E. H. Strickland (Townes). ♂, Rabbit Ears Pass, Colo., July 21, 1896, C. F. Baker (Washington). ♀, Lebanon, Conn., Aug. 18, 1946, M. Townes (Townes). ♀, Great Pond, Mt. Desert, Me., July 16, 1918, C. W. Johnson (Washington). ♂, Southwest Harbor, Me., July 14, 1925, C. W. Johnson (Washington). ♂, Labrador Lake, Cortland Co., N. Y., June 10, 1921 (Ithaca). ♂, Millwood, N. Y., June 27, 1936, H. Townes (Townes). ♂, Mud Creek, Tompkins Co., N. Y., June 17 to 20, 1904 (Ithaca). ♂, Oneonta, N.Y., Aug. 17, 1935, H. Townes (Townes). ♀, Clingmans Dome, N. C., 6600 ft., Aug. 29, 1939, H. & M. Townes (Townes). ♂, Sudbury, Ont., June 17, 1892 (Ottawa). 2 ♀, Cannon Beach, Oreg., Aug. 11, 1940, H. & M. Townes (Townes). 2 ♂, Westerly, R. I., June 27, 1946, M. Townes (Townes). ♂, Prince Albert National Park, Sask., July 20, 1941, J. G. Rempel (Townes).

This is a summer species, transcontinental in the Canadian and Transitional zones.

8. **Ctenochira gagates,** new species

Both metapleurum and second tergite conspicuously punctate; clothing hairs of ovipositor sheath short and dense; face about 1.75 as wide as long.

Forewing about 6.0 mm. long; face about 1.75 as wide as long, its lateral third with rather large punctures separated by about 1.2 their diameter; fifth segment of flagellum of both sexes (as seen from below) about 2.1 as long as wide; female flagellum with the ventral sensory areas beginning on the fourth segment; meso- and metapleurum with rather large punctures, separated by about 1.3 their diameter on the mesopleurum and by about 1.5 their diameter on the metapleurum; dorsal part of propodeum polished, smooth or weakly rugulose, with

numerous large punctures; combined basal area and areola about 1.0 as long as the petiolar area; costula usually complete, but often incomplete or almost absent; areolet present; second segment of middle tarsus of both sexes about 2.0 as long as wide; tarsal claws rather evenly and weakly curved, near the apex slightly broadened and scoop-shaped (in all other Nearctic species except *gillettei* the tarsal claws have a stronger subapical curve and are tapered to a sharp point); second tergite of male about 0.65 as long as wide, of female about 0.55 as long as wide; second tergite with large punctures separated by about 0.8 their diameter, weaker on the apical 0.2, in the male the tergite also longitudinally rugulose on its basal 0.8; epipleurum of fourth segment separated from the tergite by a fold in the male, but not in the female; female subgenital plate with erect, short, dense pubescence; ovipositor sheath about 2.2 as long as wide, its apical dorsal emargination extending about 0.30 its length; clothing hairs on ovipositor sheath short and dense, the hair sockets separated by about 0.4 the length of the hairs.

Black. Clypeus except its basal 0.15, basal half of mandible, and tegula pale yellow; palpi brown; scape often yellowish in front; apical half of mandible, sometimes all of the legs, and sometimes all of the abdomen except the basal 0.6 of first tergite and infuscation on the apical segments, ferruginous. The legs frequently have the coxae, trochanters, and most or all of the hind femur black, and the tarsi and basal part of the fore and middle femora infuscate. The black area on the abdomen may include all but the third tergite, apical 0.5 of second tergite, and all but the apical margin of the fourth tergite. Ovipositor sheath dark brown.

Type: ♀, Yakima Park, Mt. Rainier, Wash., 6500 ft., July 22, 1940, H. & M. Townes (Townes).

Paratypes: 2 ♂, Mt. McKinley, Alaska, 1932, F. W. Morand (Washington). ♀, Bilby, Alta., June 19, 1924, G. Salt (Townes). ♂, Gleichen, Alta., June 3, 1938, R. W. Salt (Townes). 2 ♂, Cameron Pass, Colo., July 30 and 31, 1896, C. F. Baker (Washington). ♂, Colo. (Washington). ♂, Dafoe, Sask., July 7, 1943, J. G. Rempel (Townes). ♂, Regina, Sask., June 14, 1940, J. G. Rempel (Townes). ♂, Sisseton Indian Reservation, South Dakota, June 23, 1927, H. C. Severin (Townes). ♂, Mt. Rainier, Wash., 5500 ft., July 23, 1940, H. & M. Townes (Townes). ♀, Mt. Rainier, Wash., 6318 ft., Aug. 13, 1931, J. Wilcox (Corvallis).

9. **Ctenochira gillettei** Davis, new combination

Figure 10

Scopiorus gillettei Davis, 1897. Trans. Amer. Ent. Soc. 24: 258. Type: ♀, Colo. (Philadelphia).

Scopiorus expansa Davis, 1897. Trans. Amer. Ent. Soc. 24: 258. Type: ♂, Mont. (Philadelphia). New synonymy.

Polyblastus scopioroides Hall, 1919. Psyche. 26: 156. Type: ♂, Woods Hole, Mass. (Cambridge).

Both metapleurum and second tergite conspicuously punctate; clothing hairs of ovipositor sheath long, of irregular length; face about 1.8 as wide as long.

Fore wing about 5.5 mm. long; face about 1.8 as wide as long, its lateral third with large punctures separated by about 0.8 their diam-

eter; fifth segment of flagellum of both sexes (as seen from below) about 2.0 as long as wide; female flagellum with ventral sensory areas beginning on the fourth or fifth segment; meso- metapleurum with rather large punctures, separated by about 0.8 their diameter on the mesopleurum and by about 1.0 their diameter on the metapleurum; dorsal part of propodeum polished, smooth or weakly rugulose, with numerous large punctures; combined basal area and areola about 1.1 as long as the petiolar area; costula absent or occasionally incomplete; areolet present; second segment of middle tarsus of male about 2.5 as long as wide, of female about 1.8 as long as wide; tarsal claws rather evenly and weakly curved, near the apex slightly broadened and scoop-shaped (in all other Nearctic species except *gagates* the tarsal claws have a stronger subapical curve and are tapered to a sharp point); second tergite of male about 0.56 as long as wide, with large punctures separated by about 2.0 their diameter, and the basal 0.75 of the tergite more or less longitudinally rugulose; second tergite of female about 0.52 as long as wide, with large punctures separated by about 1.5 their diameter; epipleurum of fourth segment separated from the tergite by a fold in the male, but not in the female; female subgenital plate with moderately short, dense, erect pubescence; ovipositor sheath about 2.3 as long as wide, its apical dorsal emargination extending about 0.25 its length (fig. 10); clothing hairs of ovipositor sheath long, of irregular length, the hair sockets separated by about 0.5 the average length of the hairs.

Black. Tegula and basal 0.65 of mandible pale yellow; clypeus except for its basal 0.2±, apical 0.35 of mandible, palpi, postero-lateral corner of pronotum, legs, and abdomen ferruginous, the legs and abdomen marked with black or infuscate as follows: coxae sometimes blackish basally; apical dorsal part of hind femur, hind tarsus, and hind tibia externally and apically infuscate; first tergite blackish basally in the female, entirely black except for the apical 0.12 to 0.4 in male; third tergite rarely somewhat infuscate; fourth and following tergites black or infuscate; ovipositor sheath and male clasper ferruginous, often somewhat infuscate. Scape and pedicel yellowish ferruginous, more or less infuscate above. Flagellum somewhat feruginous beneath to almost entirely ferruginous.

Occasional female specimens have all dark markings replaced by ferruginous. The type of *Scopiorus gillettei* is of this color variety. Other ferruginous specimens are: ♀, Vernon, (?B. C.), June 9, 1918, W. B. Anderson (Ottawa); and ♀, Cameron Pass, Colo., Aug. 19, 1940, C. E. Mickel (St. Paul). The type of *Scopiorus expansa*, a male from Montana, appears somewhat intermediate between the present species and *gagates*, but more probably belongs here.

Specimens: Many males and females from Alberta (Bilby, Edmonton, Orkney District, and Waterton); COLORADO (Cameron Pass); CONNECTICUT (Hartford); IDAHO (New Meadow at 3860 ft.); ILLINOIS (Watseka); MASSACHUSETTS (Amherst, Dorchester, Minot Co., South Hadley, Wellesley, and Woods Hole); MINNESOTA (Itasca Park); NEW JERSEY (Ramsey); NEW YORK (near Caroline, Ithaca, Junius, Peru, Rome, near Slaterville, Syracuse, and Utica); ONTARIO (Grimsby, Jordan, Ridgeway, Trenton, and Wabamic); PENNSYLVANIA (Mt.

Holly Springs and Philadelphia); OREGON (Klamath Falls); QUEBEC (Brome, Gracefield, Hull, Montreal, and St. Anne's); and RHODE ISLAND (Westerly).

This species is transcontinental in the Transitional Zone. It is normally on the wing from late May through June, but a single female was taken at Cameron Pass, Colo., on August 19. Other early and late seasonal records are May 16 at South Hadley, Mass.; May 27 at Wellesley, Mass.; May 28 at Syracuse, N. Y.; June 1 at Brome, Quebec; June 28 at Ithaca, N. Y.; June 29 at Montreal, Que., and June 30 at Waterton, Alta.

10. **Ctenochira quebecensis** Provancher, new combination

Euceros Quebecensis Provancher, 1874. Nat. Canad. 6: 30. Type: ♀, Que. (Quebec).

Tryphon flavifrons Fyles, 1893. Canad. Ent. 25: 107. Types: ♀ ♀, ex *Nematus* on *Populus*, Que. (lost).

Scopiorus monticola Brues, 1907. Bull. Wis. Nat. Hist. Soc. 5: 56. Type: ♀, Colorado Springs, Colo., 5915 ft. (Lawrence).

Tergites black; face and scape in front yellowish white, the face without extensive blackish areas; metapleurum ferruginous; second segment of middle tarsus of female wider than long; fifth flagellar segment of female 1.9 as long as wide, of male 2.1 as long as wide.

Fore wing about 5.5 mm. long; face about 1.85 as wide as long, its lateral third with small punctures separated by about 3.0 their diameter; fifth segment of male flagellum (as seen from below) about 2.1 as long as wide, of female flagellum about 1.9 as long as wide; ventral sensory areas of female flagellum beginning weakly on the fourth segment and definitely on the fifth; mesopleurum with rather small punctures separated by about 3.0 their diameter; metapleurum weakly mat and rugulose, not distinctly punctate; dorsal part of propodeum somewhat mat, largely rugulose, and with a few indistinct punctures; combined basal area and areola about 0.8 as long as the petiolar area; costula weak or absent, rarely rather strong; areolet absent; second segment of middle tarsus of male about 1.4 as long as wide, of female about 0.9 as long as wide; second tergite of male about 0.59 and of female about 0.51 as long as wide; second tergite with the apical 0.18 subpolished, the rest mat and rugulose, more strongly so in the male; epipleurum of fourth segment separated from the tergite by a fold in the male, but not in the female; female subgenital plate with moderately long, moderately dense, erect pubescence; ovipositor sheath about 2.3 as long as wide, its apical dorsal emargination occupying about 0.27 its length; clothing hairs of ovipositor sheath rather sparse, their sockets separated by about 0.8 their length.

Black. Face except for a median dorsal triangle, clypeus, mouthparts except apical part of mandible, cheek, lower part of temple, under side of scape, pedicel, basal flagellar segments, hind corner of pronotum, and tegula yellowish white; under side of flagellum more or less distinctly ferruginous; lower 0.65± of mesopleurum, often the lower part of propleurum, metapleurum, thoracic sterna, and more or less of the pleural parts of the propodeum ferruginous, the mesosternum sometimes with fuscous areas; apical part of hind tibia fuscous; hind

tarsus fuscous except that the basal 0.75 of its basitarsus is whitish; tergites and ovipositor sheath black, the apical margins of the tergites more or less distinctly ferruginous.

Specimens: ♂, 2 ♀, Riley Co., Kans., April 16, 17, and 18, F. Marlatt (Washington and Townes). 2 ♂, Plymouth, Mass., July 3, 1906, E. A. Back (Washington). ♀, reared from *Pteronidea ventralis*, Berthierville, Que., Sept. 4, 1939, L. Daviault (Ottawa). ♂, reared from "*Nematus pallidiventris*" (Washington). ♀, no data (Washington). The types are from Colorado Springs, Colo., and from Quebec.

11. **Ctenochira inflata,** new species

Tergites black; face and scape in front yellowish white, the face without extensive blackish areas; second segment of middle tarsus of female about as wide as long; fifth segment of female flagellum about 1.2 as long as wide.

Female type: Fore wing 6.3 mm. long; face 1.35 as wide as long, its lateral third with small punctures separated by about 1.5 their diameter; fifth flagellar segment (as seen from below) 1.2 as long as wide; flagellum with ventral sensory areas beginning on the second segment; mesopleurum with small punctures separated by about 2.0 their diameter; metapleurum mat, with small weak punctures separated by about 2.0 their diameter; dorsal part of propodeum mat, weakly rugulose, impunctate; combined basal area and areola 0.9 as long as the petiolar area; costula absent; areolet absent; second segment of middle tarsus 1.1 as long as wide; second tergite 0.50 as long as wide, strongly mat, the apical 0.2 smoother; epipleurum of fourth segment not separated from the tergite by a fold; subgenital plate with short, dense pubescence with a slight backward slant; ovipositor sheath 2.2 as long as wide, its apical dorsal notch extending 0.28 its length; clothing hairs of ovipositor sheath rather sparse and short, the hair sockets separated by about 0.8 the length of the hairs.

Black. Face except for a median dorsal triangle, clypeus, mouthparts except apical part of mandible, cheek, lower part of temple, under side of scape, under side of pedicel, under side of basal flagellar segments, hind corner of pronotum, thoracic sterna, lower half of mesopleurum, and tegula yellowish white; under side of flagellum except basally and apically pale ferruginous; legs pale ferruginous, the hind tibia infuscate apically and the hind tarsus fuscous with the basal 0.75 of the basitarsus whitish; postero-lateral part of propodeum, metapleurum, and lower 0.7 of mesopleurum ferruginous, grading into the yellow of the sterna; apical margins of tergites ferruginous; ovipositor sheath black.

Type: ♀, Ithaca, N. Y., June 7, 1940, H. & M. Townes (Townes)

12. **Ctenochira potens,** new species

Tergites black; front of scape brown to black; tegula ferruginous to black; hind tibia ferruginous, somewhat infuscate apically.

Female: Fore wing about 7.0 mm. long; face about 1.75 as wide as long, its lateral third with medium sized punctures separated by about 1.2 their diameter; fifth flagellar segment (as seen from below) about 2.1 as long as wide: flagellum with ventral sensory areas beginning on

the fourth segment, or as a trace on the third; mesopleurum with medium sized punctures separated by about 2.5 their diameter; metapleurum with weak, medium sized punctures separated by about 2.0 their diameter; dorsal surface of propodeum polished, weakly rugulose; combined basal area and areola about 1.05 as long as the petiolar area; costula absent; areolet absent; second segment of middle tarsus about 1.0 as long as wide; second tergite about 0.58 as long as wide, its apical 0.25 subpolished, the rest mat and ruguloso-punctate; epipleurum of fourth segment not separated from the tergite by a fold; subgenital plate with moderately long, moderately dense, erect pubescence; ovipositor sheath about 2.2 as long as wide, its apical dorsal notch occupying about 0.30 its length; clothing hairs of ovipositor sheath rather sparse, their sockets separated by about 0.8 their length.

Black. Clypeus except the basal 0.2 and mandibles yellowish, the mandible black at its base and ferruginous apically; palpi brown; scape and flagellum obscurely ferruginous beneath; tegula black or dark brown; legs dark ferruginous, the hind tibia apically and the hind tarsus infuscate. The paratype has an ill-defined whitish spot in the ventro-lateral corner of the face.

Type: ♀, Nelson, B. C., June 1, 1927, A. A. Dennys (Ottawa).

Paratype: ♀, Mt. McKinley National Park, Alaska, 1932, F. W. Morand (Washington).

13. **Ctenochira pectoralis,** new species

Tergites black; front of scape brown to black; tegula whitish; hind tibia ferruginous, somewhat infuscate apically.

Fore wing about 4.8 mm. long; face about 1.65 as wide as long, its lateral third with small punctures separated by about 2.0 their diameter; fifth flagellar segment (as seen from below) about 1.7 as long as wide in the male and about 2.0 as long as wide in the female; female flagellum with ventral sensory areas beginning on the fifth or sixth segment; mesopleurum with small punctures separated by about 3.5 their diameter; metapleurum impunctate; dorsal surface of propodeum polished, weakly rugulose; combined basal area and areola about 0.95 as long as the petiolar area; costula complete or incomplete; areolet absent; second segment of middle tarsus about 1.8 as long as wide in the male and about 1.2 as long as wide in the female; second tergite of male about 0.58 as long as wide, of female about 0.54 as long as wide; apical 0.25 of second tergite subpolished, the rest more or less mat and longitudinally rugulose, strongly so in the male; epipleurum of fourth segment not separated from the tergite by a fold; female subgenital plate with long erect pubescence, not especially dense; ovipositor sheath about 2.0 as long as wide, its apical dorsal notch extending 0.30 its length; clothing hairs of ovipositor sheath very sparse, their sockets separated by about 1.5 their length.

Black. Clypeus except its basal 0.12, basal 0.6 of mandible, often more or less of the cheek, more or less of the posterolateral corner of the pronotum, and tegula white; palpi and legs ferruginous, the hind tibia apically and the hind tarsus fuscous. In the male there is an ill-defined dark ferruginous area below the middle of the mesopleurum.

In the female the following parts of the thorax are ferruginous: lower part of propleurum, lower 0.65 of mesopleurum and adjacent part of propodeum, thoracic sterna, and a small lateral area on the collar. Under side of antenna more or less brownish or dusky ferruginous.

Type: ♀, Lac Mercier, Que., Aug. 12, 1937, G. S. Walley (Ottawa).

Paratypes: 2 ♂, Mt. Pisgah, N. C., 5000 to 5749 ft., Sept. 5, 1939, H. & M. Townes (Townes). ♀, Macdiarmid, Lake Nipigon, Ont., July 7, 1923, N. K. Bigelow (Ottawa).

14. **Ctenochira pikonematis,** new species

Scopiorus quebecensis Brown, 1941. Tech. Bull. Canad. Dept. Agr. 31: 6. Misdetermined.

Tergites black; scape whitish in front; face white with vertical blackish lines or areas of varying size; metapleurum of male black; second segment of middle tarsus of female longer than wide.

Fore wing about 5.5 mm. long; face about 1.75 as wide as long, its lateral third with moderately small punctures separated by about 1.5 their diameter; fifth flagellar segment (as seen from below) about 2.0 as long as wide in the male and about 2.3 as long as wide in the female; ventral sensory areas of female flagellum beginning on the fifth segment; mesopleurum with medium sized punctures separated by about 2.0 their diameter; metapleurum impunctate to indistinctly punctate, often weakly rugulose and mat; dorsal surface of propodeum subpolished, more or less rugulose, sometimes with some indistinct punctures; combined basal area and areola about 0.9 as long as the petiolar area; costula weak or absent; areolet absent; second segment of middle tarsus about 2.5 as long as wide in the male and about 1.25 as long as wide in the female; second tergite about 0.61 as long as wide in the male and about 0.56 as long as wide in the female; second tergite with the apical 0.25 subpolished, in the male with the basal 0.75 mat and more or less rugulose, in the female with the basal 0.75 mat to subpolished, sometimes weakly rugulose and sometimes with indistinct punctures; epipleurum of fourth segment separated from the tergite by a fold in the male, but not in the female; female subgenital plate with long, rather sparse setae slanted slightly forward; ovipositor sheath about 2.0 as long as wide, its apical dorsal notch occupying about 0.26 its length; ovipositor sheath with suberect setae and with a few subapical short erect setae, but without clothing hairs.

Black. Clypeus, mandible except at the base and apically, palpi, cheek, under side of scape and pedicel, tegula, and usually the extreme hind corner of the pronotum white; face with broad lateral marks and usually also with a median V- or U-shaped mark or pair of longitudinal streaks white; female with the thoracic sterna, lower 0.6 of mesopleurum, and the metapleurum ferruginous; male with the mesosternum and lower part of the mesopleurum often more or less distinctly ferruginous; legs ferruginous, the hind tarsus fuscous and the hind tibia apically infuscate or all but its basal part infuscate; flagellum more or less brownish or ferruginous beneath, especially in the female; apical margins of tergites more or less distinctly ferruginous.

Type: ♀, Cascapedia River, Que., July 12, 1935, M. L. Prebble (Ottawa).

Paratypes: ♀, reared from a larva of *Pikonema alaskensis* collected at Grand Is., Mich., July 28, 1907 (Washington). ♀, Upper Ten Mile, Ore., Aug. 2, 1931 (Corvallis). 2 ♂, Cascapedia River, Que., July 6 and 7, 1935, M. L. Prebble (Ottawa). 15 ♂, 1 ♀, reared in 1939 and 1941 from Quebec by the Canadian Forest Insect Survey, from *Pikonema alaskensis*, (5 localities), from *Pikonema dimmockii* (5 localities), and from *Pikonema* sp., the localities as follows: Franquelin, Havre St. Pierre, Kamouraska, Maniwaki, Moisie River, Restigauche, Riv. au Tonverre, St. Urbain, Temiscauata, and several other localities not decipherable from the labels (Ottawa). ♂, ex *Pikonema alaskensis*, Thwart Is., Newfoundland, emerged in incubator April 10, 1939 (Ottawa).

This species is transcontinental in the Canadian Zone and a common parasite of *Pikonema* (Tenthredinidae).

15. **Ctenochira infans,** new species

Face black; hind tibia uniformly ferruginous; areolet absent; first tergite of female broad, with the median dorsal carinae ending near its middle.

Fore wing about 5.0 mm. long; face about 1.75 as wide as long, its lateral third with moderately small punctures separated by about 1.5 their diameter; fifth flagellar segment (as seen from below) about 1.7 as long as wide in the male and 1.85 as long as wide in the female; female flagellum with ventral sensory areas beginning on the third or as a trace on the second segment; mesopleurum with rather small punctures separated by about 1.5 their diameter; metapleurum with more or less distinct small punctures separated by about 2.0 their diameter, all but its upper third rugulose; dorsal surface of propodeum polished, more or less rugulose, impunctate; combined basal area and areola about 1.1 as long as the petiolar area; costula usually absent, sometimes weak or incomplete; areolet absent; second segment of middle tarsus about 2.3 as long as wide in the male and about 1.15 as long as wide in the female; median dorsal carinae of second tergite ending near its midlength in the female, extending farther in the male; second tergite about 0.55 as long as wide in the male and 0.50 as long as wide in the female; second tergite mat, the basal 0.8 in the female more or less longitudinally rugoso-punctate, in the male strongly longitudinally rugoso-punctate; epipleurum of fourth segment not separated from the tergite by a fold; pubescence of female subgenital plate moderately long, dense, erect or slanted a little forward; ovipositor sheath about 2.3 as long as wide, its apical dorsal notch occupying about 0.30 its length; clothing hairs of ovipositor sheath rather long and sparse, their sockets separated by about 0.8 their length.

Black. Clypeus and basal 0.6 of mandible yellowish; palpi and apical 0.4 of mandible ferruginous; under side of antenna more or less stained with ferruginous; tegula white; legs ferruginous, often the coxae and trochanters more or less blackish, sometimes the femora basally infuscate, often the hind tarsus infuscate, and sometimes the apical part of the hind tibia faintly infuscate; abdomen either entirely black or ferruginous marked as follows: basal 0.75 to entire first tergite

black, second tergite often blackish basally, and abdomen beyond the third or fourth tergites infuscate or black.

Type: ♀, Mt. McKinley National Park, Alaska, 1932, F. W. Morand (Washington).

Paratypes: 3 ♀, Churchill, Man., Aug. 2 to 9, 1937, R. H. Daggy (St. Paul and Washington). 5 ♂, 6 ♀, collected with the type (Washington and Townes).

The female paratypes from Churchill are somewhat more extensively ferruginous and have the tarsal and flagellar segments longer than in the series from Mt. McKinley. Their fifth flagellar segment averages 1.95 as long as wide and their second segment of the middle tarsus 1.8 as long as wide.

16. **Ctenochira extricata** Davis, new combination

Scopiorus extricatus Davis, 1897. Trans. Amer. Ent. Soc. 24: 259. Type: ♀, Colo. (Philadelphia).

Face black; abdomen and hind tibia entirely ferruginous, areolet absent.

Female: Fore wing about 5.7 mm. long; face about 1.65 as wide as long, its lateral third with moderately small punctures separated by about 1.5 their diameter; fifth flagellar segment (as seen from below) about 1.8 as long as wide; ventral sensory areas of flagellum beginning on the third segment; mesopleurum with medium sized punctures separated by about 1.4 their diameter; metapleurum impunctate or with a few medium sized punctures, more or less mat and with its lower 0.5 rugose; dorsal surface of propodeum subpolished or somewhat mat, rather smooth; combined basal area and areola about 1.1 as long as the petiolar area; costula absent; areolet absent; second segment of middle tarsus about 1.15 as long as wide; second tergite about 0.57 as long as wide, mat and weakly rugulose, the apical 0.25 smoother and more polished; epipleurum of fourth segment not separated from the tergite by a fold; pubescence on subgenital plate rather short, dense, and with a distinct backward slope; ovipositor sheath about 2.1 as long as wide, its apical dorsal notch occupying about 0.37 its length; clothing hairs of ovipositor sheath moderately dense, their sockets separated by about 0.4 their length.

Black. Clypeus except its basal 0.15 and basal 0.6 of mandible yellowish white; apical 0.4 of mandible, palpi, legs, and abdomen ferruginous; tegula white; ovipositor ferruginous basally, the rest more or less black; apex of hind femur and of hind tibia sometimes lightly infuscate.

Specimens: ♀, Banff, Alta., July 14, 1938, C. H. Townes (Townes). 2 ♀, 5 miles south of The Dalles, Ore., May 5, 1938, K. Gray and J. Schuh (Corvallis and Townes). ♀, bred from "willow sawfly," Wenatchee, Wash., May 23, 1916, E. J. Newcomer (Washington).

17. **Ctenochira dilatata** Provancher

Face usually more or less ivory white; mesoscutum black; third tergite ferruginous; areolet absent.

Fore wing about 4.8 mm. long; face about 1.63 as long as wide, its lateral third with small punctures separated by about 2.0 their diam-

eter; fifth flagellar segment (as seen from below) about 1.9 as long as wide in the male and 2.0 as long as wide in the female; ventral sensory areas of female flagellum beginning on the fifth segment; mesopleurum with very small punctures separated by about 3.0 their diameter; metapleurum not distinctly punctate; dorsal surface of propodeum polished, weakly rugulose or almost smooth, impunctate; combined basal area and areola about 1.1 as long as the petiolar area; costula absent, or sometimes present and weak; areolet absent; second segment of middle tarsus about 1.7 as long as wide in the male and 1.4 as long as wide in the female; second tergite about 0.59 as long as wide in the male and 0.57 as long as wide in the female, the tergite subpolished and longitudinally rugulose, coarsely so in the male and weakly so in the female, its apical 0.25 subpolished and smooth; epipleurum of fourth segment not separated from the tergite by a fold; pubescence of female subgenital plate rather short, dense, and slanted somewhat forward; ovipositor sheath about 2.2 as long as wide, its apical dorsal notch occupying about 0.35 its length; clothing hairs of ovipositor sheath rather sparse, their sockets separated by about 0.8 their length.

Ctenochira dilatata is divisible into two subspecies, one east and one west of the Rocky Mountains. They may be differentiated on color as described below.

17a. **Ctenochira dilatata dilatata** Provancher, new combination

Catocentrus dilatatus Provancher, 1875. Nat. Canad. 7:316. Type: ♂, Que. (Quebec).

Black. Face except for a narrow median dorsal triangle extending about half its length, cheek, clypeus, basal half of mandible, palpi, scape and pedicel beneath, postero-lateral corner of pronotum, and tegula white; flagellum more or less ferruginous beneath, paler in the female than in the male, and in the female the basal one or two segments whitish beneath; legs ferruginous, the hind femur somewhat infuscate above at its apex, the hind tibia blackish apically and often somewhat infuscate subbasally, and the hind tarsus infuscate; first tergite ferruginous or usually more or less black; second tergite ferruginous or often more or less black, sometimes entirely black except at the base and apex; third tergite ferruginous to black except at the base; fourth and following tergites black, the fourth tergite sometimes with ferruginous marks; ovipositor sheath and male clasper black.

Specimens: ♂, 10 miles east of Washington, D. C., July 11, 1926, H. S. Barber (Washington). ♀, The Pas, Man., Aug. 11, 1937, D. G. Denning (St. Paul). ♀, Bowie, Md., May 30, 1945, H. & M. Townes (Townes). ♂, South Hadley, Mass., Oct. 1, 1935, M. Townes (Townes). ♂, Hanover, N. H., C. M. Weed (Washington). ♀, McLean, N. Y., Aug. 31, 1925 (Ithaca). ♀, Milford Center, N. Y., Aug. 13, 1935, H. Townes (Townes). ♀, Oneonta, N. Y., Aug. 24, 1935, H. Townes (Townes). ♂, ♀, Pisgah Mt., N. C., 5000 to 5749 ft., Sept. 5, 1939, H. & M. Townes (Townes). 5 ♂, ♀, Pisgah Mt., N. C., 4800 to 5300 ft., June 21, 1940, H. & M. Townes (Townes). ♀, Georgeville, Que., May 20, 1936, G. S. Walley (Ottawa). ♀, Hull, Que., Aug. 14, 1897, Harrington (Ottawa). ♀, Oct. 3, 1897 (no further data, but apparently

labeled by Harrington and therefore from the vicinity of Ottawa, Ont.) (Ottawa).

This subspecies occurs in the east, from Manitoba and Quebec south to North Carolina. It is on the wing from late spring until fall.

17b. **Ctenochira dilatata niveicola** Ashmead, new combination

Scorpiorus (*!*) *alaskensis* Ashmead, 1902. Proc. Wash. Acad. Sci. 4: 214. Type: ♀, Popof Is., Alaska (Washington). New synonymy.
Scorpiorus (*!*) *niveicola* Ashmead, 1902. Proc. Wash. Acad. Sci. 4: 214. Lectotype hereby selected: ♂, Popof Is., Alaska, July 9, 1899, T. Kincaid (Washington).
Scopiorus plagosus Hall, 1919. Psyche 26: 159. Type: ♀, Yellowstone Park, Wyo., 8200 ft. (Cambridge). New synonymy.

Differs from *Ctenochira dilatata dilatata* only in color as follows: Face with a median vertical black stripe of varying width separating the lateral whitish areas, sometimes the face entirely black or with a white spot in the ventro-lateral corner; clypeal suture between the foveae blackish; white of cheek sometimes reduced to a small spot; apex of hind femur not infuscate; sometimes the hind tibia and tarsus without infuscation; fourth and following tergites black to blackish stained with ferruginous.

Specimens: ♀, Muir Inlet, Alaska, June 12, 1899, T. Kincaid (Washington, paratype of *niveicola*). ♂, Edmonton, Alta., July 6, 1932, O. Peck (Ottawa). ♂, Inverness, Calif., May 22, 1940, E. C. VanDyke (San Francisco). ♀, Inverness, Calif., Oct. 6, 1946, H. Townes (Townes). ♂, ♀, Cannon Beach, Ore., Aug. 6, 1940, H. & M. Townes (Townes). ♀, Mt. Rainier, Wash., 4700 ft., July 11, 1940, H. & M. Townes (Townes).

This subspecies occurs in Alaska and in the United States and Canada west of the Rocky Mountains.

18. **Ctenochira rubicunda,** new species

Thorax ferruginous; face whitish with light ferruginous stains; tegula white.

Female type: Fore wing 5.3 mm. long; face 1.75 as wide as long, its lateral third with small punctures separated by about 2.0 their diameter; fifth flagellar segment (as seen from below) 2.4 as long as wide; ventral sensory areas of flagellum beginning on the fourth segment; mesopleurum with medium sized punctures separated by about 1.2 their diameter; metapleurum with rather small weak punctures separated by about 1.2 their diameter; dorsal surface of propodeum polished, with indistinct weak punctures; combined basal area and areola 0.9 as long as the petiolar area; costula absent; areolet absent; second segment of middle tarsus 1.6 as long as wide; second tergite 0.42 as long as wide, weakly punctato-rugulose, the apical 0.2 smoother; epipleurum of fourth segment separated from the tergite by a weak fold; pubescence on subgenital plate rather short, dense, and slanting somewhat forward; ovipositor sheath 2.0 as long as wide, its apical dorsal notch occupying 0.27 its length; clothing hairs of ovipositor sheath moderately long and sparse, their sockets separated by about 0.3 their length.

Ferruginous. Clypeus, cheek, and face whitish, with light ferruginous stains; tegula white; part of frons and most of top of head and

occiput infuscate; scape and pedicel pale ferruginous anteriorly, the pedicel and upper part of scape infuscate posteriorly; most thoracic sutures, propodeal carinae, and base of first tergite blackish; apex of hind femur and of hind tibia lightly infuscate; fifth and following tergites and the ovipositor sheath fusco-ferruginous.

Type: ♀, reared from a sawfly cocoon, Fredericton, N. B., May 31, 1933, C. E. Atwood (Ottawa).

19. **Ctenochira ferrugata,** new species

Mesoscutum, face, and tegula ferruginous; second segment of middle tarsus of female about 2.0 as long as wide.

Female: Fore wing about 5.5 mm. long; face about 1.75 as wide as long, its lateral third with small punctures separated by about 1.8 their diameter; fifth flagellar segment (as seen from below) about 2.0 as long as wide; ventral sensory areas of flagellum beginning on the fourth segment, with a trace on the third; mesopleurum with medium sized punctures separated by about 1.7 their diameter; metapleurum impunctate or with weak indistinct punctures; dorsal surface of propodeum polished, smooth, impunctate; combined basal area and areola about 1.0 as long as the petiolar area; costula absent; areolet present or absent; second segment of middle tarsus about 2.0 as long as wide; second tergite about 0.54 as long as wide, weakly punctato-rugulose, the apical 0.2 smoother; epipleurum of fourth segment separated from the tergite by a weak fold; pubescence of subgenital plate of moderate length, rather dense, erect; ovipositor sheath about 2.5 as long as wide, its apical dorsal emargination occupying about 0.34 its length; clothing hairs of ovipositor sheath rather dense, their sockets separated by about 0.3 their length.

Ferruginous. Clypeus, mouthparts, and lower lateral corners of face pale ferruginous; occiput, most of the thoracic sutures, propodeal carinae, and extreme base of first tergite black; flagellum somewhat infuscate above, especially towards the base; legs uniformly ferruginous.

Type: ♀, Lake George, Mt. Rainier, Wash., 4200 ft., July 15, 1940, H. & M. Townes (Townes).

Paratype: ♀, collected with the type (Townes).

20. **Ctenochira picta,** new species

Flagellum with a median white band; abdomen, hind femur, and propodeum ferruginous.

Female: Fore wing about 5.5 mm. long; face about 1.6 as wide as long, its lateral third with small punctures separated by about 1.5 their diameter; fifth flagellar segment (as seen from below) about 2.6 as long as wide; ventral sensory areas of flagellum beginning on the eighth segment; mesopleurum with small punctures separated by about 3.0 their diameter; metapleurum with very small, weak punctures; dorsal surface of propodeum polished, smooth, impunctate; combined basal area and areola about 1.3 as long as the petiolar area; costula weak and incomplete, or absent; areolet absent; second segment of middle tarsus about 2.0 as long as wide; second tergite about 0.52 as long as wide, polished, nearly smooth; epipleurum of fourth segment not sep-

arated from the tergite by a fold; pubescence of subgenital plate short, dense, erect; ovipositor sheath about 3.0 as long as wide, its apical dorsal notch occupying about 0.34 its length; clothing hairs of ovipositor sheath rather dense, their sockets separated by about 0.3 their length.

Ferruginous. Head whitish, the frons except laterally, and the occiput black, the black of the occiput often extended laterally to the upper posterior part of the eye; mouthparts whitish, the apical part of the mandible brownish ferruginous; scape, pedicel, and basal two or three segments of flagellum whitish below and blackish above; remainder of flagellum blackish except for a white band on about the ninth to sixteenth segments; lower part and postero-lateral corner of pronotum, lower part or most of propleurum, mesosternum, lower fourth and anterior margin of mesepisternum, mesepimeron, scutellum, postscutellum, spot in center of mesoscutum, line along notaulus, a broad lateral mark on the mesoscutum, and tegula white; mesonotum and metanotum black or blackish except where noted as white; upper central part of lateral face of pronotum and upper fourth of mesepisternum black; first and second lateral areas of propodeum sometimes infuscate; trochanters, fore coxae, most of middle coxae, and base of tibiae whitish; hind tibia with a subbasal and an apical fuscous band, its central part stramineous; middle tibia banded like the hind but less distinctly; fore tibia with a subbasal infuscation; hind tarsus stramineous, the apical part of the basitarsus and most of the rest of the segments somewhat infuscate; tergites sometimes infuscate laterally; ovipositor sheath brown.

Type: ♀, Westport, Washington, July 17, 1940, H. & M. Townes (Townes).

Paratypes: ♀, Robson, B. C., Aug. 6, 1939, H. R. Foxlee (Townes). ♀, Ithaca, N. Y., June 2, 1936, H. Townes (Townes). ♀, Mt. Pisgah, N. C., 5000 to 5749 ft., Sept. 5, 1939, H. & M. Townes (Townes).

21. **Ctenochira frigida** Cresson, new combination

Figure 8

Bassus frigidus Cresson, 1868. Trans. Amer. Ent. Soc. 2: 111. Type: ♀, Great Slave Lake, N. W. T. (Philadelphia).

Tergites black; hind tibia infuscate apically and subbasally, sometimes also externally.

Fore wing about 5.3 mm. long; face about 1.65 as wide as long, its lateral third with small punctures separated by about 2.0 their diameter; fifth flagellar segment of male (as seen from below) about 2.1 as long as wide, of female about 2.2 as long as wide; ventral sensory areas of female flagellum beginning on the third segment; mesopleurum with small punctures separated by about 2.5 their diameter; metapleurum impunctate or with fine weak punctures; dorsal surface of propodeum polished and more or less rugulose, impunctate; combined basal area and areola about 1.0 as long as the petiolar area; costula weak or absent; areolet absent; second segment of middle tarsus about 1.8 as long as wide in the male and 1.3 as long as wide in the female; second tergite about 0.69 as long as wide in the male and 0.61 as long as wide in the female, strongly mat and finely rugulose, the apical 0.25 smoother;

epipleurum of fourth segment separated from the tergite by a fold; pubescence on female subgenital plate short, dense, and erect; ovipositor sheath about 3.3 as long as wide, its apical dorsal notch occupying about 0.39 its length (fig. 8); clothing hairs of ovipositor sheath rather dense, their sockets separated by about 0.3 their length.

Black. Clypeus except often its basal margin, basal 0.5 of mandible, palpi, usually the hind corner of pronotum, and tegula white; apical 0.5 of mandible ferruginous; female and often the male with metapleurum, lower 0.65 of mesopleurum, mesosternum, and sometimes part of the propleurum ferruginous, the mesosternum sometimes yellowish ferruginous; fore leg ferruginous, its tibia basally whitish; coxae, trochanters, and femora of middle and hind legs ferruginous, the apices of their femora usually infuscate above; hind tibia white to dusky stramineous, with a subbasal and broad apical fuscous band, sometimes the bands connected by a fuscous stripe externally and rarely the hind tibia almost uniformly fuscous except for a pale basal band; hind tarsus blackish, the basal part of the first segment broadly and of the second and third segments more narrowly white or stramineous; middle tibia and tarsus faintly repeating the coloration of the hind tibia and tarsus but usually tinged with ferruginous; apical margin of tergites more or less pale; ovipositor sheath and male claspers black.

Specimens: ♂, 5 ♀, Matanuska, Alaska, Sept. 2 to Oct. 6, 1945, J. C. Chamberlin (Washington). ♂, Mt. McKinley National Park, Alaska, 1932, F. W. Morand (Washington). ♀, Bilby, Alta., June 19, 1924, George Salt (Washington). ♀, Edmonton, Alta., Aug. 20, 1932, O. Peck (Townes). ♀, Lake Louise, Alta., July 29, 1938, G. S. Walley (Ottawa). ♀, Vermillion Lake, Banff, Alta., 4500 ft., Aug. 17, 1925, O. Bryant (Washington). ♂, ♀, Cameron Pass, Colo., July 30, 1896, C. F. Baker (Washington). ♀, Forrester's Ranch, Colo., Aug. 3, 1896, C. F. Baker (Washington). ♀, 20 miles south of Churchill, Man., Aug. 5 to 6, 1937, D. G. Denning (St. Paul). ♂, Brevort, Mich., Aug. 9, 1936, C. W. Sabrosky (Townes). ♀, Cameron Bay, Great Bear Lake, N. W. T., July 12, 1937, T. N. Freeman (Ottawa). ♂, Scappoose, Ore., May 5, 1936, Schuh and Gray (Corvallis). 2 ♂, reared from sawfly, Yakima, Wash., May 21, E. J. Newcomer (Washington). ♂, reared from *Pteronidea vancouverensis*, Yakima, Wash., May, 1919, E. J. Newcomer (Washington).

This species is probably transcontinental in the Hudsonian and Canadian zones, but has not yet been taken east of Manitoba and Michigan. The Yakima record indicates that it may also be looked for in the Transitional Zone. The three specimens from Colorado seem to represent a distinct race, lacking the apical infuscation on the middle and hind femora and having the banding on the hind tibia and tarsus quite suffused.

22. **Ctenochira deplanata,** new species

Second tergite without a transverse impression.

Forewing about 4.6 mm. long; face longitudinally convex, about 1.5 as wide as long, its lateral third with small punctures separated by about 1.5 their diameter; fifth flagellar segment of both sexes (as seen from below) about 1.8 as long as wide; ventral sensory areas of female

flagellum beginning at the apex of the third segment; mesoscutum polished, with sparse, very small punctures, especially sparse in the female (more densely punctate in other Nearctic species); mesopleurum with small punctures separated by about 4.0 their diameter; metapleurum with small punctures separated by about 2.5 their diameter; dorsal surface of propodeum subpolished, largely rugose; combined basal area and areola about 1.25 as long as the petiolar area; costula very weak; areolet absent; second segment of middle tarsus about 2.0 as long as wide in the male and 1.0 as long as wide in the female; second tergite about 0.68 as long as wide in the male and 0.80 as long as wide in the female, subpolished, the basal 0.5 medially longitudinally rugulose, the rest nearly smooth; second tergite without a broad, transverse, weak, postmedian groove (this present in all other Nearctic species); epipleurum of fourth segment of male separated from the tergite on its basal 0.65 by a weak fold, not separated in the female; subgenital plate rather small, its pubescence rather sparse, long, and erect; ovipositor sheath 1.1 as long as wide, its dorsal apical notch extending 0.30 its length; ovipositor sheath with suberect setae but without appressed clothing hairs.

Black. Face, clypeus, sides of frons, cheek, lower end of temple, basal 0.65 of mandible, palpi, ventral and hind parts of pronotum, tegula, coxae except basally, trochanters, and knees yellow; antenna dark brown above, the scape, pedicel, and basal two flagellar segments yellow beneath and the rest of the flagellum light brown beneath; coxae basally ferruginous or in the male the hind coxa black at the base; femora ferruginous except apically, the hind femur darkest; hind tibia and tarsus brownish, the tibia yellow basally; tergites ferruginous, the first tergite black except for its apical margin medially, the second black except for about its apical 0.22, the third with a pair of blackish sublateral areas, and in the male the rest of the tergites somewhat darkened ferruginous with the apical part rather yellowish, most broadly yellowish medially; ovipositor sheath and male clasper yellowish.

Type: ♀, Isle Royal, Mich., Aug. 3 to 7, 1936, C. Sabrosky (Washington).

Paratype: ♂, Pagosa Springs, Colo., C. F. Baker (Washington).

Genus **Erromenus**

Figures 12 to 21

Subtegula ridge an upright flange that reaches lower edge of the tegula; ovipositor and its sheath upcurved.

Fore wing 3.5 to 7.0 mm. long; body and legs very short and stout; clypeus oval, transversely evenly convex, longitudinally convex to almost flat, its apical margin often with an inconspicuous fringe of short setae; clypeal foveae often enlarged and filled with long setae; cheek 0.2 to 0.4 as long as the basal width of the mandible; posterior mandibular condyles a little closer together than are the eyes at the level of the clypeal foveae; outer face of mandible at its basal 0.2 moderately convex to almost flat, with rather large punctures; postero-lateral corner of pronotum somewhat incrassate and projecting a little; subtegular ridge projecting upwards as a thin flange that touches the lower

edge of the tegula when the latter is not raised (figs. 12, 16, and 17); tegula convex; areolet present or absent, when present oblique; second recurrent vein evenly curved, with two widely separated bullae; nervellus broken at its lower 0.2 to 0.35; tarsal claws usually pectinate on their basal 0.5 or more, sometimes on as little as their basal 0.3, and rarely apparently simple; second tergite smooth or with a shallow oblique furrow on each side cutting off the baso-lateral corners, mat to polished, coarsely punctate to impunctate; ovipositor sheath strongly upcurved, rigid, usually quite short (figs. 13 to 15 and 18 to 21); ovipositor upcurved, usually quite short.

Erromenus is related to *Polyblastus* and *Ctenochira* as noted under *Polyblastus*.

KEY TO THE SUBGENERA OF ERROMENUS

1. Anterior half of margin of subtegular ridge straight or weakly convex, the ridge touching the tegula (when the tegula is not raised) through most of its anterior half (fig. 16); epomia complete and strong, extending well below the pronotal sulcus; tarsal claws pectinate, conspicuously so in the female but often inconspicuously and only basally in the male: latero-apical part of clypeus not impressed; basal corners of petiole not unusually strong; ovipositor larger, its sheath wider and at least 0.7 as long as the subgenital plate (figs. 13 to 15 and 18 to 21); sixth and seventh tergites of female short, each projecting little or not at all beyond the preceding tergite, subgenus **Erromenus**

Anterior half of margin of subtegular ridge concave and well separated from the tegula (fig. 17); epomia short, weak, and indistinct, not extending below the pronotal sulcus; tarsal claws apparently not pectinate; latero-apical part of clypeus somewhat impressed; basal corners of petiole very strong; ovipositor very small, its sheath narrow, without setae, and only 0.3 as long as the subgenital plate; sixth and seventh tergites of female long, each projecting conspicuously beyond the preceding tergite, subgenus **Aderaeon**

Subgenus **Erromenus**

Figures 12 to 16 and 18 to 21

Erromenus Holmgren, 1855. Svenska Vet.-Akad. Handl. 1: 221. Type: *Tryphon brunnicans* Gravenhorst. Designated by Viereck 1912.

? *Trichocalymma* Foerster, 1868. Verh. Naturh. Ver. Preuss. Rheinlande. 25: 196. Type: *Trichocalymma bipunctatum* Woldstedt. Designated by Viereck, 1914.

Currania Viereck, 1924. Can. Ent. 56: 30. Type: (*Currania mirabilis* Viereck) = *analis* Brischke. Monobasic.

Clypeus with its lateral apical parts not impressed, usually strongly convex; epomia complete and strong, extending well below the pronotal sulcus; anterior half of subtegular ridge straight or weakly convex, the ridge reaching the tegula (when the tegula is not raised) throughout most of its anterior half; tarsal claws pectinate, at least basally, though in males of many species the pectination is so sparse and short as to be difficult to see; basal corners of petiole not unusually strong; sixth and seventh tergites of female each projecting but little or sometimes not at all beyond the preceding tergite; subgenital plate of female not unusually long; ovipositor sheath with a few to many setae, not unusually small and at least 0.7 as long as the subgenital plate.

Most species have a small pale basal mark on the outer side of each tibia, quite distinct in some but indistinct in others.

The American species of the subgenus *Erromenus* divide into four species groups as follows:

1. *Marginatus* group. Seventh tergite of female with a median apical transverse brush of long setae, some with upturned apices (figs. 13 and 14); second tergite with a pair of shallow oblique basal grooves; tarsal claws of female pectinate almost to the apex; areolet present. Included are the Holarctic *analis* and *punctulatus*, the Nearctic *brevipes*, *levis*, *scorteus*, *marginatus*, *defrictus*, *proteus*, *dimidiatus* and *glabrosus*, the Palaearctic *frenator* Gravenhorst 1829, and doubtless a number of other Palaearctic species. The species *analis* is exceptional in having the apical hair brush of the female seventh tergite reduced to a few setae and the female tarsal claws not pectinate to the apex. *E. glabrosus* has the basal grooves on the second tergite subobsolete. The European *E. brunnicans* Gravenhorst 1829 agrees with this group in the characters stated but has enormous clypeal foveae and the occipital carina rather straight below, instead of incurved sharply to the hypostomal carina.

2. *Ungulatus* group. Seventh tergite of female very deep to accommodate the long ovipositor, but not otherwise specialized (fig. 15); second tergite without oblique basal grooves; ovipositor sheath as long as the first tergite; areolet absent; lower part of mesopleurum with fine sparse punctures. Included is a single Nearctic species, *E. ungulatus*.

3. *Caelator* group. Seventh tergite of female variously modified, apically with rather long erect setae (figs. 19 to 21); second tergite without oblique basal grooves; clypeal foveae very large; ovipositor sheath rather slender; tarsal claws pectinate on about their basal 0.75; areolet present; included are five species differing from one another most clearly in the female seventh tergite. These are the Nearctic *planus*, *caelator*, and *nasalis* and two undetermined European species. We have seen a single female from Jaffrey, N. H. (Cambridge) which appears to represent a fourth Nearctic species (undescribed).

4. *Variolae* group. Seventh tergite of female retractable so that only its apical margin is visible and the apical part of the abdomen appears as a hollow lined largely with intersegmental membrane (fig. 18); ovipositor sheath rather elliptical, flat and polished; tarsal claws of female sparsely pectinate on not more than their basal 0.65; second tergite without oblique basal grooves; occipital carina often not quite reaching the hypostomal carina, or weak or indistinct at its juncture with the hypostomal carina; areolet present or absent. Included are four diverse Nearctic species: *labratus*, *tonto*, *dolichops*, and *variolae*.

KEY TO THE AMERICAN SPECIES OF THE SUBGENUS ERROMENUS

1. Second tergite with a pair of shallow oblique basal furrows that cut off its baso-lateral corners to slightly beyond the spiracles, *or* when the furrows are indistinct (in some *E. glabrous*), the lateral carina of the scutellum extending 0.8 its length; seventh tergite of female with an apical, usually transverse, brush of setae, of which some have upturned apices (figs. 13 and 14); front tarsal claws of female pectinate practically to the apex (except in *E. analis*), of the male inconspicuously pectinate on the basal 0.4 to 0.75 (*marginatus* group) 2

Second tergite without distinct oblique basal furrows; seventh tergite without an apical brush of setae, or when there is such a brush (in *E. nasalis*, fig. 21) the apices of the setae are not upturned and the brush is not transverse; front tarsal claws frequently pectinate on less than their basal 0.5 11

2. Second and third tergites black, blackish, or in *E. levis* reddish brown, each usually with a narrow apical pale border.....3
   Second and third tergites largely or entirely ferruginous.....8
3. Face strongly protuberant (especially in the female), its greatest protuberance below the middle; abdomen black, fulvous apically; thorax and abdomen narrower than in any other species of the genus.....3. **analis**
   Face less protuberant, its greatest protuberance above the middle.....4
4. Lower half of mesopleurum with sparse weak punctures separated from one another by about 3 times their diameter; fore wing 3.5 to 4.2 mm. long....5
   Lower half of mesopleurum with moderately dense medium sized punctures separated from one another by 1.2 to 2.5 times their diameter; fore wing 4.5 to 6.0 mm. long.....6
5. Hind coxa black; second and third tergites sparsely and finely punctate; tarsi slightly shorter than usual.....1. **brevipes**
   Hind coxa ferruginous; second and third tergites very sparsely and finely punctate; tarsi of normal length.....2. **levis**
6. Petiolar area with a single strong complete median vertical carina; second and third tergites completely mat; coxae usually black.....5. **punctulatus**
   Petiolar area without a median vertical carina or with two or three weak and usually incomplete vertical carinae; second and third tergites usually more or less polished; coxae ferruginous.....7
7. Abdominal tergites with moderately dense punctures, those on the second tergite separated from one another by about 0.5 the length of their setae; lateral portions of mesoscutum with moderately dense punctation, 6. **marginatus**
   Abdominal tergites with sparse punctures, those on the second tergite separated from one another by about 1.0 the length of their setae; lateral portions of mesoscutum with sparse punctation.....7. **defrictus**
8. Apical abdominal tergites, beginning with the fourth or fifth, black or strongly infuscate; upper margin of antennal socket projecting as a flange about 0.5 as high as the scape is wide; frons strongly impressed near the antennal sockets.....10. **dimidiatus**
   Apical abdominal tergites ferruginous; upper margin of antennal socket forming a weak flange that projects by only about 0.15 the diameter of the scape; frons not strongly impressed near the antennal sockets.....9
9. Lateral carina of scutellum extending about 0.8 its length; hind part of lateral margin of mesoscutum elevated as a lamina about 0.55 to 0.7 as high as the tegula is wide; wings usually smoky.....8. **glabrosus**
   Lateral carina of scutellum extending 0.25 to 0.5 its length; hind part of lateral margin of mesoscutum elevated as a lamina 0.2 to 0.4 as high as the tegula is wide; wings hyaline or subhyaline.....10
10. Basal carina of propodeum not strongly dipped into the top of the petiolar area, strong and approximately straight across the top of the petiolar area; ovipositor sheath strongly convex apically and at the margins, the rest flatter; second and third tergites distinctly punctate.....9. **proteus**
    Basal carina of propodeum strongly dipped into the top of the petiolar area, the dipped portion of the carina weak and irregular; ovipositor sheath rather uniformly convex; second and third tergites mat and very weakly and inconspicuously punctate.....4. **scorteus**
11. Lower half of mesopleurum with fine, rather sparse punctures separated from one another by more than 3.0 their diameter; ovipositor sheath about 1.05 as long as the first tergite (fig. 15); areolet absent; femora and tarsi slightly shorter than usual, the hind femur about 0.7 as long as the hind tibia (*ungulatus* group).....11. **ungulatus**
    Lower half of mesopleurum with medium sized punctures separated from one another by 1.0 to 1.8 their diameter; ovipositor sheath not more than 0.6 as long as the first tergite (figs. 18 to 21); areolet present or absent; femora and tarsi of normal length, the hind femur about 0.8 as long as the hind tibia.....12
12. Clypeus very weakly transversely convex, about 2.7 to 3.1 as wide as long; front tarsal claws not pectinate beyond the basal 0.33; abdomen black or black with the apex fulvous; ovipositor and seventh tergite as described in second half of couplet 14 (*variolae* group, in part).....13
    Clypeus rather strongly transversely convex, about 2.0 to 2.5 as wide as long; front tarsal claws pectinate on their basal 0.4 to 0.75.....14

13. Femora ferruginous ..... 15. **labratus**
Femora black ..... 16. **tonto**
14. Occipital carina strong and distinct to the hypostomal carina; female with the seventh tergite not capable of complete invagination (figs. 19 to 21); ovipositor sheath convex, tapered to a blunt point (figs. 19 to 21); front tarsal claws of female rather densely pectinate on the basal 0.75 (*caelator* group) 15
Occipital carina not quite reaching the hypostomal carina or reaching it but weak and indistinct at the juncture; female with the seventh tergite invaginated, or capable of invagination, so that only its apical margin is visible and the apex of the abdomen contains a concave area lined largely with intersegmental membrane (fig. 18); ovipositor sheath rather flat (fig. 18); front tarsal claws of female sparsely pectinate on the basal 0.55 to 0.65 (*variolae* group, in part) 17
15. Seventh tergite of female with a median apical rounded nose-like prominence (fig. 21); second tergite of both sexes punctate and more or less mat ..... 14. **nasalis**
Seventh tergite of female without an apical rounded prominence; second tergite of both sexes punctate and polished or slightly mat 16
16. Seventh tergite of female with a large flattened medioapical area bearing upright setae (fig. 19), the apical margin of the tergite unspecialized (fig. 19A); ovipositor sheath about 0.75 as long as the subgenital plate; hind coxa usually ferruginous ..... 12. **planus**
Seventh tergite of female with a median apical chisel-like decurved tooth (figs. 20 and 20A); ovipositor sheath about 1.1 as long as the subgenital plate; hind coxa black ..... 13. **caelator**
17. Clypeus between the foveae convex in profile, separated from the face by a strong groove; cheek 0.5 to 0.8 as wide as the basal width of the mandible; abdomen usually largely ferruginous; areolet absent ..... 17. **dolichops**
Clypeus between the foveae flat in profile, separated from the face only by a difference in sculpture; cheek about 0.3 as wide as the basal width of the mandible; abdomen black; areolet usually present ..... 18. **variolae**

1. **Erromenus (Erromenus) brevipes,** new species

Fore wing about 3.8 mm. long; abdomen black, the second tergite with oblique basal grooves; petiolar area without a median vertical carina; coxae usually black; tarsi and femora slightly shorter than usual.

Fore wing about 3.8 mm. long; cheek about 0.22 as long as the basal width of the mandible; lower half of mesopleurum with fine punctures separated by about 3.0 their diameter; legs unusually short, the hind femur about 0.7 as long as the hind tibia (about 0.8 as long in most species), and the third segment of the front tarsus slightly longer (♂) or slightly shorter (♀) than long; front tarsal claws of male coarsely pectinate on their basal 0.5; petiolar area of moderate size, hexagonal with its top side shortened, without median vertical carinae; second tergite about 0.6 as long as wide, finely and sparsely punctate, subpolished with the basal corners mat; setiferous part of ovipositor sheath about 1.0 as long as subgenital plate. Agrees otherwise with the structural description of *E. marginatus*.

Black. Clypeus and mandible red-brown, both blackish basally; palpi brown; tegula brown; its antero-lateral part paler; coxae black, rarely ferruginous; trochanters black to infuscate ferruginous or rarely ferruginous; legs beyond trochanters light ferruginous brown, the femora (especially the hind ones) usually more or less infuscate except at the apex; tibiae with an indistinct external basal pale mark; second and following tergites with the apical margin narrowly pale red-brown, the apical segments with the margins slightly wider.

Type: ♀, north end of Paradise Valley at 5300 ft. (timberline), Mt. Rainier, Wash., Aug. 16, 1940, H. & M. Townes (Townes).

Paratypes: 3 ♂, ♀, collected with the type (Townes). ♀, Sunrise Ridge at 5500 ft. (timberline), Mt. Rainier, Wash., July 23, 1940, H. & M. Townes (Townes).

2. **Erromenus (Erromenus) levis,** new species

Fore wing about 4.0 mm. long; second and following tergites dark brownish ferruginous margined apically with paler, subpolished and very weakly punctate; lower half of mesopleurum with fine punctures separated by about 3 times their diameter.

Fore wing about 4.0 mm. long; clypeus about 2.3 as wide as long; cheek about 0.2 as long as the basal width of the mandible; lower half of mesopleurum with fine punctures separated by about 3.0 their diameter; front tarsal claws of male coarsely pectinate on their basal 0.5; petiolar area large, hexagonal with the top side shortened and somewhat concave, without median vertical carinae or with a pair of weak irregular ones; second tergite about 0.6 as long as wide, sparsely punctate with very fine punctures, subpolished with the basal corners mat; setiferous part of ovipositor sheath about 1.0 as long as the subgenital plate. Agrees otherwise with the structural description of *E. marginatus.*

Black. Mandible yellow, apically dark ferruginous; clypeus ferruginous, its basal margin infuscate; palpi ochraceous; scape and pedicel ferruginous, infuscate above; flagellum dark brown; tegula yellow; legs ferruginous, the tibiae each with a rather distinct external basal pale mark; abdomen dark brownish red, paler apically, the second and following tergites with a narrow ochraceous apical margin, the margin wider on the apical segments.

Type: ♀, Taughanic Falls, N. Y., Aug., 1925 (Ithaca).

Paratypes: 2 ♂, "on sawfly," no other data (Washington and Townes).

3. **Erromenus (Erromenus) analis** Brischke

Figure 14

Erromenus analis Brischke, 1871. Schrift. phys.-ökon. Gesell. Königsberg, 11: 95. Types: ♂, ♀, Prussia.

Currania mirabilis Viereck, 1924. Canad. Ent. 56: 301. Type: ♀, Aylmer, Que. (Ottawa). New synonymy.

Face strongly bulging just above the clypeus; body exceptionally narrow.

Fore wing about 4.3 mm. long; face very strongly bulging, most strongly bulging just above the clypeus; clypeus transversely convex, longitudinally convex at its extreme base but the rest of its length flat in profile; cheek about 0.2 as long as the basal width of the mandible; mandible exceptionally slender; entire thorax and abdomen exceptionally long and slender, together with the protuberant face giving an *Exochus*-like appearance; lower half of mesopleurum with fine to medium sized punctures separated from one another by 2 to 4 times their diameter; hind part of mesoscutal margin elevated as a narrow lamina about 0.2 as high as the tegula is wide; scutellum with lateral

carinae at its basal corners only; front tarsal claws of both sexes coarsely pectinate on their basal 0.75; combined basal area and areola of propodeum about 1.9 as long as wide; petiolar area circular, narrowly concave at the top, without a median vertical carina; second tergite about 0.85 as long as wide, in the male mat with its apical 0.12 subpolished, in the female subpolished and with sparse fine punctures; sixth and seventh tergites of female each distinctly projecting from the preceding tergite, the seventh compressed and with a small median apical tuft of long setae with upturned tips (fig. 14); setiferous part of ovipositor sheath about 1.0 as long as the subgenital plate. Agrees otherwise with the structural description of *E. marginatus*.

Black. Clypeus and mandibles brownish ferruginous; palpi ochraceous; scape stained with ferruginous beneath; tegula yellow; front and middle coxae ferruginous to black; hind coxa dusky ferruginous to black; legs beyond coxae ferruginous, the hind femur frequently more or less infuscate except at the apex; hind tibia and tarsus sometimes darkened; tibiae each with a distinct basal pale mark; second and following tergites with the apical margin fulvous; apex of abdomen entirely fulvous, in the female sometimes as far basad as the apex of the third tergite, in the male not uniformly fulvous basad of the sixth tergite.

Specimens: ♀, Fairbanks, Alaska, June 30, 1921, J. M. Aldrich (Townes). ♀, Jesmond, B. C., Aug. 28, 1938, J. K. Jacob (Ottawa). ♀, Colo. (Washington). ♀, Morley, Colo., Aug. 26, 1940, H. & M. Townes (Townes). ♂, Cranberry Lake, N. Y., Aug. 14, 1924, E. A. Hartley (Washington). ♂, ♀, Cranberry Lake, N. Y., Aug. 19, 1924, E. A. Hartley (Washington and Townes). ♀, Moosonee, Ont., July 19, 1934, G. S. Walley (Ottawa). ♀, Sweetburg, Que., July 6, 1936, G. S. Walley (Ottawa). ♀, Spearfish, S. D., July 26, 1924 (Washington). 2♂, ♀, Mt. Rainier, at 4700 and at 5300 ft., Wash., Aug. 17, 1940, H. & M. Townes (Townes).

This species is transcontinental in the Canadian Zone of North American and occurs also in northern Europe. American specimens have been compared with a female from England, lent to us by Mr. J. F. Perkins of the British Museum. The species has been reared in Europe from *Pontania capreae*.

4. **Erromenus (Erromenus) scorteus,** new species

Apical propodeal carina strongly dipped into the petiolar area; second tergite mat, not distinctly punctate; abdomen mostly ferruginous.

Fore wing about 4.8 mm. long; cheek about 0.28 as long as the basal width of the mandible; lower half of mesopleurum punctatorugulose, the punctures weak, separated from one another by about 2 times their diameter; hind part of mesoscutal margin elevated as a lamina that is about 0.25 as high as the tegula is wide; lateral scutellar carina extending about 0.4 its length; front tarsal claws of male coarsely pectinate on about their basal 0.65; combined basal area and areola of propodeum about 1.1 as long as wide; petiolar area of moderate size, hexagonal with its top side strongly concave where the areola pushes downward into the periolar area, the carina separating the areola and

petiolar area usually weak and irregular; petiolar area without a median vertical carina; second tergite about 0.65 as long as wide, very finely punctate, mat with the apical 0.12 subpolished; setiferous portion of ovipositor sheath about 1.0 as long as the subgenital plate. Agrees otherwise with the structural description of ***E. marginatus.***

Black. Clypeus and mandible brownish ferruginous; palpi light brown; tegula light brown, its anterior-lateral part paler; coxae and first trochanters ferruginous piceous to black; second trochanters ferruginous to black; legs beyond trochanters ferruginous, the tibiae each with an indistinct basal pale mark; second and following tergites ferruginous, frequently indefinitely margined laterally with black or blackish; second tergite usually with a large median basal infuscate area; third and following tergites often somewhat infuscate basally, rarely the apical tergites entirely blackish.

Type: ♀, Snoqualmie Pass, Wash., July 3, 1940, H. & M. Townes (Townes).

Paratypes: ♂, ♀, collected with the type (Townes). ♀, Colo. (Washington). ♂, Mt. Rainier at 5300 ft., Wash., Aug. 17, 1940, H. & M. Townes (Townes).

5. **Erromenus (Erromenus) punctulatus** Holmgren

Figure 12

Erromenus punctulatus Holmgren, 1855. Svenska Vet-Akad. Handl. 1: 222. Type: ♂, Sweden (?Stockholm).

Tryphon crassus Cresson, 1868. Trans. Amer. Ent. Soc. 2: 107. Type: ♀, New Jersey (Philadelphia). New synonymy.

Tryphon tejonicus Cresson, 1878. Proc. Acad. Nat. Sci. Phila., p. 372. Type: ♂, Ft. Tejon, Calif. (Philadelphia).

Polyblastus leviculus Davis, 1897. Trans. Amer. Ent. Soc. 24: 263. Type: ♂, Colo. (Philadelphia).

Petiolar area with a strong median vertical carina; abdomen black.

Fore wing about 5.4 mm. long; cheek about 0.32 as long as the basal width of the mandible; lateral carina of scutellum extending about 0.4 its length; combined basal area and areola of propodeum about 0.9 as long as wide; petiolar area of moderate size, with a single strong vertical carina, rounded hexagonal but its top side deeply notched; lateral section of apical carina sloping upwards from the petiolar area; second tergite about 0.7 as long as wide, very finely punctate, strongly mat with the apical margin subpolished; ovipositor sheath very convex and stubby-looking, its setiferous part about 0.9 as long as the subgenital plate. Agrees otherwise with the structural description of *E. marginatus.*

Black. Clypeus brownish red on its apical 0.7 ±; mandible brownish red apically; palpi dark brown; tegula light brown, slightly paler antero-laterally; coxae black, rarely ferruginous or infuscate ferruginous; trochanters black to infuscate ferruginous or ferruginous; legs beyond trochanters ferruginous; second and following tergites with the apical margin usually narrowly red-brown.

A male from Mt. Marcy, N. Y., has the propodeum quite smooth rather than strongly rugulose as in the rest of the specimens, and the coxae ferruginous but infuscate basally. A female from McLean,

N. Y., and another from Keremeos, B. C., have the coxae entirely ferruginous. A female from Beulah, N. M., has the coxae piceous and ferruginous. All other specimens before us have the coxae black. We have compared Nearctic material with a male in the National Museum from Crefeld, Germany, determined as *punctulatus* by Ulbricht, and find no important differences.

Specimens: ♂, Edmonton, Alta., May 27, 1924, Owen Bryant (Washington). 4♀, Matanuska, Alaska, June 6 to 11, 1945, J. C. Chamberlin (Washington). ♀, Keremeos, B. C., June 18, 1923, C. B. Garrett (Ottawa). ♀, Likely, B. C., July 7, 1938, G. S. Walley (Ottawa). ♀, Bar Harbor, Me., May 26, 1934 (Washington), bred from sawfly. ♂, Mt. Madison, N. H., June 24, 1938, H. & M. Townes (Townes). ♀, Beulah, N. M., June 29, 1902 (Philadelphia). ♀, Artist's Brook, Essex Co., N. Y., June 23, 1940, H. Dietrich (Ithaca). ♀, Connecticut Hill at 2095 ft., Tompkins Co., N. Y. (Townes). ♂, Mt. Marcy, N. Y., June 26, J. N. Belkin (Townes). ♀, McLean, N. Y., May 29, 1937, H. Townes (Townes). ♂, McLean, N. Y., May 31, 1913 (Ithaca). ♀, Saranac Lake, N. Y., July 19, 1946, R. T. Mitchell (Mitchell). ♂, ♀, Sudbury, Ont., June 16 and 17, 1892 (Ottawa). ♂, Hat Point, Wallowa Co., Ore., July 30, 1941, G. R. Ferguson (Corvallis). ♂, Hideaway, Ore., Aug. 14, 1913, W. D. Edmonston (Washington). ♂, Bolton Glen, Que., June 5, 1936, G. S. Walley (Ottawa). ♂, Brome, Que., June 2, 1936, G. S. Walley (Ottawa). ♂, Knowlton, Que., June 11, 1936, G. S. Walley (Ottawa). ♀, Mt. Lyall, Que., June 28, 1933, C. C. Smith (Ottawa). 5 ♂, 10 ♀, Mt. Rainier at 2900 ft., 3800 ft., 4200 ft., 4700 ft., and 5500 ft., Wash., July 7, 15, 19, 21, and 23, 1940, H. & M. Townes (Townes).

In the Nearctic Region this species occurs across the continent in the Canadian and Hudsonian zones. In the Palearctic Region it is known from northern and central Europe. There seems to be a single generation a season. In the southern Canadian Zone, adults appear about May 25; in the Hudsonian Zone as late as the middle of July. The author's experience collecting the species on Mt. Rainier indicates a short period of flight, perhaps two weeks for the period of abundance. It has been reared in Europe from *Amauronematus forsiusi*.

6. **Erromenus (Erromenus) marginatus** Provancher

Erromenus marginatus Provancher, 1883. Nat. Canad. 14: 10; Faune, p. 797. Type: ♀, Cap Rouge, Que. (Quebec).

Abdomen black; coxae ferruginous; second tergite of female with moderately coarse punctures separated by about 0.5 the length of their setae; ovipositor sheath convex.

Fore wing about 5.0 mm. long; face most strongly bulging just below the antennal sockets, medially with rather coarse sharp punctures, sublaterally the punctures finer and denser, and laterally the punctures fine and sparse; clypeus about 2.5 as wide as long, transversely convex and longitudinally convex with a flattening centered just beyond its midlength; clypeal suture a furrow, deepened at the foveae into well-marked somewhat elongate pits that are much narrower than the basal diameter of the apical flagellar segment; cheek about 0.21 as long

as the basal width of the mandible; occipital carina complete, strong at its juncture with the hypostomal carina; lower half of mesopleurum with rather small punctures separated from one another by about 1.5 their diameter; hind part of mesoscutal margin elevated as a lamina that is about 0.3 as high as the tegula is wide; lateral carina of scutellum extending about 0.35 its length; areolet present; front tarsal claws of male sparsely pectinate on their basal 0.75, of the female densely pectinate practically to the tips; combined basal area and areola of propodeum about 1.0 as long as wide; petiolar area large, hexagonal with the top side concave, often with two weak irregular median vertical carinae; lateral section of apical propodeal carina horizontal; dorsal carinae of first tergite strong and sharp, ending about 0.12 from the apex of the tergite; second tergite about 0.63 as long as wide, with a pair of broad shallow oblique basal furrows that cut off its latero-basal corners to a little beyond the spiracle, in and basad of the furrows somewhat more mat and rugose than elsewhere; second tergite of male mat with about the apical 0.15 subpolished, finely to moderately finely punctate; second tergite of female subpolished with the basal corners mat, with moderately coarse punctures; sixth and seventh tergites of female projecting little beyond the previous tergite, the seventh above rounded off, its postero-dorsal face with long setae and its apex with a posteriorly projecting transverse brush of setae, some of which have upturned apices; ovipositor sheath ovate, upcurved, strongly convex, with a mucronate tip, the setiferous part of the sheath about 0.85 as long as the subgenital plate.

Black. Clypeus brownish ferruginous to pale ferruginous, the basal 0.3± black; mandible yellow, apically dark ferruginous; palpi pale brownish ferruginous to brown; scape and pedicel somewhat stained with ferruginous below; tegula yellow, apically often somewhat brownish; legs ferruginous, the hind tarsal segments somewhat infuscate apically and the tibiae each with a basal external yellow mark; apical margin of second and following tergites brownish ferruginous.

Specimens: ♂, Edmonton, Alta., July 25, 1932, O. Peck (Townes). ♀, Edmonton, Alta., Aug. 12, 1932, E. H. Strickland (Townes). ♀, Jesmond, B. C., Aug. 26, 1938, J. K. Jacob (Ottawa). ♀, Barago Co., Mich., Aug. 4, 1937, R. R. Dreisbach (Dreisbach). ♂, Isabella Co., Mich., May 30, 1938, R. R. Dreisbach (Townes). ♀, Isle Royal, Mich., Aug. 3 to 7, 1936, R. R. Dreisbach (Dreisbach). ♀, Douglas Lake, Mich., Aug. 11, 1922 (Ithaca). ♀, Franconia, N. H. (Washington). ♂, Saranac Lake, N. Y., June 6, 1946, R. T. Mitchell (Mitchell). ♂, Cleveland, Ohio, June 9, 1935, C. H. Kennedy (Columbus). ♀, Spring Brook, Pa., Aug. 13, 1944, H. Townes (Townes). ♀, Hazleton, Pa., Sept., 1896, W. G. Dietz (Washington). ♀, Lehigh Gap, Pa., July 24, 1913 (Philadelphia). ♂, Bolton Glen, Que., June 5, 1936, G. S. Walley (Ottawa). ♀, Knowlton, Que., June 15, 1936, G. S. Walley (Ottawa). ♀, Lac Mercier, Que., Aug. 17, 1937, G. S. Walley (Ottawa). ♀, Hopkington, R. I., Aug. 31, 1946, M. Townes (Townes). ♂, Mt. Rainier at 2900 ft., Wash., July 7, 1940, H. & M. Townes (Townes). ♂, Mt. Rainier at 5300 ft., Wash., Aug. 16, 1940, H. & M. Townes (Townes). 3 ♂, bred from larva of "*Nematus*" on *Corylus* by H. G. Dyar (Washington).

The data at hand indicates an occurrence across the continent in the Transitional and Canadian zones. Adults appear to be on the wing throughout the summer. Three males were bred from a "*Nematus*" larva on *Corylus* by H. G. Dyar.

7. **Erromenus (Erromenus) defrictus,** new species

Abdomen black; coxae ferruginous; second tergite of female with sparse punctures separated by about the length of their setae; ovipositor sheath rather flat, the margins convex.

Fore wing about 5.2 mm. long; lower half of mesopleurum with medium sized punctures separated from one another by about 1.7 their diameter; hind part of mesoscutal margin elevated as a lamina about 0.35 as high as the tegula is wide; lateral carina of scutellum extending about 0.2 its length; hind tarsus somewhat shorter than in *E. marginatus;* petiolar area rather large, broadly rounded hexagonal with the top side shortened and flattened or somewhat concave, usually with two weak irregular vertical carinae; second tergite about 0.6 as long as wide, in the female polished and with sparse moderately fine punctures, the punctures separated by about the length of their setae; ovipositor sheath rather flat with the margins convex, the setiferous part about 1.0 as long as the subgenital plate. Agrees otherwise with the structural description of *E. marginatus*. The above description is from female specimens only. When the male becomes known, it may be found to have the second tergite less polished than does the female and the tarsal claws pectinate either more or less extensively than in the male of *E. marginatus*.

Hind tibia somewhat infuscate apically. Otherwise colored like *E. marginatus*.

Type: ♀, Sligo Park near the Washington Sanitarium, Takoma Park, Md., July 23, 1943, M. Townes (Townes).

Paratypes: 2 ♀, taken at the type locality, June 23, 1943, and July 6, 1943, M. Townes (Townes).

The types were swept from the undergrowth of open woods.

8. **Erromenus (Erromenus) glabrosus** Davis

Erromenus glabrosus Davis, 1897. Trans. Amer. Ent. Soc. **24**: 260. Type: ♂, southern Calif. (Philadelphia).

Lateral carina of scutellum extending 0.8 its length; wings usually smoky.

Fore wing about 5.5 mm. long; clypeus about 2.2 as wide as long; cheek about 0.2 as long as the basal width of the mandible; mesopleurum strongly bulging just above its middle; lower half of mesopleurum with moderately fine punctures separated by about 2.0 their diameter; hind part of mesoscutal margin elevated as a lamina that is 0.55 to 0.7 as high as the tegula is wide; lateral carina of scutellum extending about 0.8 its length; tarsal claws of both sexes rather long and weakly curved, rather sparsely pectinate to near the apex; combined basal area and areola of propodeum about 1.25 as long as wide; petiolar area of moderate size, rounded hexagonal with the top side much shortened, unusually smooth and with a blunt median vertical carina; lateral section of apical carina sloping slightly upwards from the petiolar area, or horizontal; first tergite with the dorsal carinae ending 0.5 to

0.3 from its apex; second tergite about 0.57 as long as wide, strongly convex, its basal oblique grooves weak; second tergite polished and with rather fine sparse punctures; ovipositor sheath rather flat, the margins convex, its setiferous part about 0.9 as long as the subgenital plate. Agrees otherwise with the structural description of *E. marginatus*.

Black. Apical 0.75 of clypeus dark ferruginous; mandible piceous basally, yellowish medially, and ferruginous apically; palpi brown; tegula yellow, its apical third brownish; wings usually smoky (subhyaline to hyaline in the other Nearctic species); coxae piceous; trochanters brownish to ferruginous; legs beyond trochanters ferruginous, each tibia with a basal external yellow mark; hind tarsus somewhat infuscate; abdomen of the female entirely ferruginous, or the extreme base of the first tergite infuscate; abdomen of the male ferruginous, usually the first tergite black or piceous and the second and sometimes also the following tergites with a baso-lateral fuscous stain.

A male from Aweme, Man., has the wings subhyaline, the dorsal carina of the first tergite ending about 0.3 from the apex, and the postero-lateral part of the mesoscutal margin about 0.55 as high as the tegula is wide. All of our other specimens have the wings smoky, the dorsal carina of the first tergite ending about 0.5 from the apex, and the postero-lateral part of the mesoscutal margin about 0.7 as high as the tegula is wide. The specimen from Manitoba may represent a distinct subspecies or species.

Specimens: ♂, Truckee, Calif., June 19, 1927, E. P. Van Duzee (San Francisco). ♀, Colorado (Washington). ♂, Aweme, Man., May 27, 1925, R. D. Bird (Ottawa), atypical, see paragraph above. ♀, Cornucopia, 7100 ft., Ore., July 25, 1936, R. E. Rieder (Corvallis). ♂, Eagle Ridge, Klamath Lake, Ore., May 19, 1924, C. L. Fox (Townes). ♂, Seneca, Ore., July 11, 1935, Joe Schuh (Townes). ♀, Wind R., Wyo. (allotype, Philadelphia).

9. **Erromenus (Erromenus) proteus,** new species

Abdomen beyond the first tergite ferruginous; second tergite with oblique basal grooves; top side of petiolar area with a strong carina, not semicircularly concave.

Fore wing about 4.4 mm. long; cheek about 0.28 as long as the basal width of the mandible; lower half of mesopleurum with medium sized punctures that are separated by about 2 times their diameter; front tarsal claws of male coarsely pectinate on their basal 0.55; combined basal area and areola of propodeum about 0.9 as long as wide; petiolar area sharply hexagonal with its top side somewhat concave, without or with several ill-defined median vertical carinae or sometimes with a single strong carina; second tergite about 0.6 as long as wide, mat with the apical 0.1± subpolished, with fine to moderate sized punctures; ovipositor sheath strongly convex apically and at the margins, the rest flatter; setiferous part of ovipositor sheath about 0.8 as long as the subgenital plate. Agrees otherwise with the structural description of *E. marginatus*.

Black. Apical 0.7 of clypeus brownish ferruginous; mandible yellow, apically ferruginous; palpi brownish stramineous; tegula yellow, usually more or less brownish apically; coxae black or piceous, the front coxae often brownish ferruginous; first trochanters piceous to

ferruginous; legs beyond first trochanters ferruginous, the second trochanters and the hind tarsus more or less infuscate and each tibia with a more or less distinct basal external yellow mark; first tergite apically ferruginous; second and following tergites ferruginous, frequently with indefinite brownish areas.

The paratype males of this species are somewhat diverse in propodeal carination and abdominal sculpture. Possibly they represent more than one species.

Type: ♀, Paradise Valley at 4700 ft., Mt. Rainier, Wash., July 21, 1940, H. & M. Townes (Townes).

Paratypes: ♂, Edmonton, Alta., June 11, 1932, O. Peck (Townes). ♂, Mammoth Lakes, Calif., July 15, 1933, Bohart (Bohart). ♂, ♀, Norman Co., Minn., June 21, 1923, A. A. Nichol (St. Paul). ♀, Alpine Garden, Mt. Washington, N. H., Aug. 30, 1937, A. L. Melander (Cambridge). 2 ♂, Waskesiu Lake, Sask., July 22, 1939, A. R. Brooks (Ottawa). ♀, Washington Territory (Philadelphia).

10. **Erromenus** (**Erromenus**) **dimidiatus** Cresson

Figures 13 and 16

Tryphon dimidiatus Cresson, 1868. Trans. Amer. Ent. Soc. 2: 108. Type: ♂, New Jersey (Philadelphia).

Tryphon atricoxus Walsh, 1873. Trans. Acad. Sci. St. Louis 3: 104. Type: ♀ (?), Ill. (?) (type destroyed).

Scopiorus hiatus Davis, 1897. Trans. Amer. Ent. Soc. 24: 258. Type: ♀, Agricultural College, Mich. (Philadelphia).

Abdomen black basally and apically, ferruginous in the middle; upper margin of antennal socket produced.

Fore wing about 5.8 mm. long; cheek about 0.25 as long as the basal width of the mandible; upper margin of antennal socket projecting as a flange about 0.5 as high as the scape is wide; frons strongly impressed near the antennal sockets (this is the only species of *Erromenus* known to us with the margin of the antennal socket and the frons as described above); lower half of mesopleurum with medium sized punctures separated from one another by about 1.5 their diameter; hind part of mesoscutal margin elevated as a flange about 0.35 as high as the tegula is wide; lateral carina of scutellum extending about 0.45 its length; front tarsal claws of male coarsely pectinate on their basal 0.45; combined basal area and areola of propodeum about 1.2 as long as wide; petiolar area of moderate size, hexagonal with the top and bottom sides shortened, without median vertical carinae or with two or three weak irregular ones; second tergite about 0.6 as long as wide, subpolished and rather coarsely punctate; ovipositor sheath strongly convex apically and at the margins, the rest rather flat (fig. 13); setiferous part of ovipositor sheath about 0.82 as long as the subgenital plate. Agrees otherwise with the structural description of *E. marginatus*.

Black. Apical 0.6 of clypeus brownish ferruginous; mandible more or less stained with ferruginous; palpi brown; tegula brown, yellow antero-laterally; trochanters reddish piceous to black; legs beyond trochanters ferruginous, each tibia with an external basal yellow mark; first tergite apically in the middle ferruginous; second, third, and usually also the fourth tergites ferruginous; fifth and following tergites

black or sometimes stained with ferruginous, their apical margins ferruginous.

Specimens: Many males and females from ALASKA (Curry and Matanuska); ALBERTA (Banff, Bilby, Edmonton, and Wabamun); BRITISH COLUMBIA (Carbonate on the Columbia River at 2600 ft. and Howser in the Selkirk Mts.); CALIFORNIA (Coffee Creek at Big Flat in Tuolume Co.); COLORADO; CONNECTICUT (Hartford); IDAHO (Juliaetta); KANSAS (Lawrence); MAINE (Bar Harbor, Medomak, and Narrows on Mt. Desert Island); MANITOBA (Aweme and The Pas); MASSACHUSETTS (Amherst, Brookline, Dorchester, Gloucester, Milton, South Hadley, and Wellesley); MICHIGAN (Agricultural College, Cedar River, Cheboygan Co., and Missaukee Co.); MINNESOTA (Carlton, Fridley Sand Dunes in Anoka Co., Itasca Park, Grand Rapids, and Ramsey Co.); NEW BRUNSWICK (Frederickton); NEW HAMPSHIRE (Glen House, Hanover, Jaffrey, and Pinkham Notch); NEW YORK (Ava, Danby, Horton, Homer, Ithaca, Lancaster, Long Island, McLean, Oswego, Peru, Rock City in Cattaraugus Co., Saranac Lake, Speculator, Syracuse, Taughannock Falls, Utica, and West Nyack); NOVA SCOTIA (Baddeck, South Milford, and Truro); ONTARIO (Constance Bay and Sudbury); OREGON (near Headquarters of Crater Lake Park at 6600 ft.); PENNSYLVANIA (Harrisburg, North Cumberland, Spring Brook, Swarthmore, and West Newton); QUEBEC (Aylmer, Brome, Georgeville, Joliette, Knowlton, Lanoraie, Montreal, St. Annes', St. Johns, and Sweetsburg); SASKATCHEWAN (Prince Albert National Park); VERMONT (Bennington and Lake Willoughby); and WASHINGTON (Mt. Baker, and Mt. Rainier at 4700 ft, 5300 ft., and 5500 ft.).

This is the commonest Nearctic *Erromenus*. It occurs in the Transitional, Canadian, and Hudsonian zones across the continent. At Spring Brook, Pa., a populous colony was found in grass along a roadside and it appears likely that grassy places are the normal habitat. Most species of *Erromenus* occur among shrubs. Adults are on the wing in mid-spring, reach a peak of abundance in late spring or early summer, and disappear about the middle of the summer, or somewhat later in more northern localities. A single generation a year is indicated by this seasonal distribution. Early and late collecting dates of interest are April 20 in Douglas Co., Kansas; May 7 at Spring Brook, Pa.; May 15 at South Hadley, Mass.; May 22 at North Cumberland, Pa.; May 27 at Brookline and at Wellesley, Mass.; May 29 in Missaukee Co., Mich.; May 30 at Syracuse, N. Y.; May 31 at Brome, Que.; July 26 at Horton, N. Y.; Aug. 8 on Montreal Island, Que.; Aug. 11 in Cheboygan Co., Mich.; Aug. 17 at 5300 ft. on Mt. Rainier, Wash.; Aug. 20 at Edmonton, Alta.; and Aug. 26 at Cedar River, Mich.

11. **Erromenus (Erromenus) ungulatus,** new species

Figure 15

Areolet absent; mesopleurum very weakly and sparsely punctate; ovipositor sheath about 1.05 as long as the first tergite.

Fore wing about 4.2 mm. long; face most strongly bulging just below the antennal sockets, medially with rather coarse sharp punctures, sublaterally with punctures finer and denser, and laterally with punctures fine and sparse; clypeus about 2.5 as wide as long, convex

transversely and convex longitudinally but with a flattening centered just beyond the middle; central 0.5 of apical margin of clypeus very weakly convex; clypeal suture a furrow, deepened at the foveae into well-marked somewhat elongate pits that are much narrower than the basal diameter of the apical flagellar segment; cheek about 0.22 as long as the basal width of the mandible; occipital carina complete, strong at its juncture with the hypostomal carina; lower half of mesopleurum with fine sparse punctures separated by more than 3 times their diameter; postero-lateral margin of mesoscutum elevated as a lamina that is about 0.2 as high as the tegula is wide; lateral carina of scutellum extending about 0.3 its length; areolet absent; flagellar segments, tarsi, and femora unusually short, the hind femur about 0.73 as long as the hind tibia; front tarsal claws of male sparsely pectinate on the basal 0.75, of the female rather densely pectinate to near the apex; combined basal area and areola of propodeum about 0.9 as long as wide; petiolar area large, sharply hexagonal with its upper side somewhat shortened and more or less concave, without a median vertical carina; lateral section of apical carina horizontal, very short; dorsal carinae of first tergite sharp and rather strong, ending about 0.18 from the apex of the tergite; second tergite about 0.5 as long as wide, without distinct oblique basal furrows, very finely punctate and more or less mat and longitudinally rugulose to subpolished with the apical 0.2 polished; sixth and seventh tergites each projecting far beyond the preceding tergite, the seventh of the female very deep and obliquely placed so as to accommodate the exceptionally long ovipositor, but otherwise unspecialized; ovipositor sheath very long, tapering gradually from the base to the blunt apex, more strongly curved basally than apically, roundly convex in cross section, the setiferous part of the sheath about 2.7 as long as the subgenital plate and 1.05 as long as the first tergite (fig. 15).

Black. Clypeus, mandible, and usually the under side of scape and pedicel fulvous, the basal 0.25± of the clypeus dark brown; palpi pale ferruginous; flagellum usually somewhat stained with fulvous, especially beneath; tegula pale ferruginous; legs ferruginous, rarely the coxae somewhat infuscate; apical 0.2 of first tergite and all of the following tergites ferruginous, rarely the first tergite almost entirely black or piceous and the apical tergites somewhat infuscate.

Type: ♀, Ithaca, N. Y., May 29, 1934, H. Townes (Townes).

Paratypes: ♀, McLean Reserve, Tompkins Co., N. Y., May 22, 1937, H. Townes (Townes). ♀, Six Mile Creek Valley, Ithaca, N. Y., June 15, 1935, P. P. Babiy (Townes). ♂, Pisgah Mt. at 4800 to 5300 ft., N. C., June 21, 1940, H. & M. Townes (Townes). ♀, Niagara Glen, Ont., June 10, 1926, G. S. Walley (Ottawa). ♂, Mt. Rainier at 4200 ft., Wash., July 15, 1940, H. & M. Townes (Townes). ♀, Mt. Rainier at 5300 ft., Wash., Aug. 16, 1940, H. & M. Townes (Townes).

12. **Erromenus (Erromenus) planus,** new species

Figure 19

Clypeal foveae very large; seventh tergite of female with a median, apical flat, down-sloping area bearing erect setae; male not easily distinguished from that of E. caelator or of E. nasalis.

Fore wing about 4.5 mm. long; seventh tergite of female with a large medio-apical flat area sloping downwards towards the apex of the tergite and bearing rather long erect setae (fig. 19), the apical margin of the tergite unspecialized (fig. 19A); ovipositor sheath about 0.75 as long as the subgenital plate (fig. 19). Agrees otherwise with the structural description of *E. caelator*.

Black. Mandible ferruginous; clypeus and palpi pale ferruginous, the basal 0.35± of the clypeus black; scape usually fulvous beneath; tegula yellow, postero-mesally pale ferruginous to brownish; legs ferruginous, rarely the hind and middle coxae piceous and the front coxae and basal trochanters somewhat infuscate; tibiae each with an external basal yellow mark; apical 0.2 to 0.35 of first tergite and all of the following tergites ferruginous.

Type: ♀, about 5 miles north of Troy, N. Y., Sept. 2, 1934, H. Townes (Townes).

Paratypes: ♀, Edmonton, Alta., July 2, 1945, E. H. Strickland (Townes). ♀, British Columbia, 1939 (Townes). ♀, Felton at 300 to 500 ft., Santa Cruz Mts., Calif., May 15 to 19, 1907, J. C. Bradley (Ithaca). ♂, Felton at 300 to 500 ft., Santa Cruz Mts., Calif., May 20 to 25, 1907, J. C. Bradley (Ithaca). ♂, Poughkeepsie, N. Y., Aug. 11, 1936, H. Townes (Townes). ♀, Prince Albert National Park, Sask., July 20, 1941, J. G. Rempel (Townes). Since males of this species do not possess good diagnostic characters, the true identity of the two male paratypes is open to question.

13. **Erromenus (Erromenus) caelator,** new species

Figure 20

Clypeal foveae very large; seventh tergite of female with an apical, downcurved, chisel-like tooth; male not easily distinguished from that of E. nasalis or of E. planus.

Fore wing about 4.6 mm. long; face most strongly bulging just below the antennal sockets, medially with large indistinct punctures that are somewhat confluent, laterally almost impunctate; clypeus about 2.1 as wide as long, convex transversely and convex longitudinally but with a flattening centered just below the middle; clypeal suture a furrow, deepened at the foveae into a pair of large deep pits slightly larger than the basal diameter of the apical flagellar segment, the pits partially obscured by setae; cheek about 0.5 as long as the basal width of the mandible; occipital carina reaching the hypostomal carina, strong and sharp at its juncture; lower half of mesopleurum with medium sized punctures separated by about 1.4 their diameter; hind part of mesoscutal margin elevated as a lamina about 0.3 as high as the tegula is wide; lateral carina of scutellum extending about 0.45 its length; areolet present; front tarsal claws of male sparsely pectinate on their basal 0.7, of the female with moderately dense pectination on their basal 0.75; combined basal area and areola of propodeum about 0.9 as long as wide; petiolar area of moderate size, subcircular to roundly hexagonal, usually longer than broad, the top side more or less concave, without or sometimes with a median vertical carina; lateral section of apical carina horizontal; second tergite about 0.6 as long as wide, polished or somewhat mat, rather coarsely punctate; female with the

sixth and seventh tergites each projecting a little beyond the preceding tergite, the seventh tergite decurved apically and with a median apical chisel-like projecting tooth (figs. 20 and 20A); ovipositor sheath about 1.1 as long as the subgenital plate, finger-like, convex, evenly upcurved, and tapered to its bluntly pointed apex (fig. 20).

Black. Mandible ferruginous, slightly infuscate basally; clypeus and palpi pale ferruginous, the basal 0.35± of the clypeus black; tegula yellow, postero-mesally brownish ferruginous; legs ferruginous, the hind coxae piceous, the middle coxae ferruginous piceous, and the front coxae and basal trochanters more or less infuscate ferruginous; tibiae each with a basal external yellow mark; apical 0.1 to 0.3 of first tergite and all of the following tergites ferruginous.

Type: ♀, Ithaca, N. Y., May 30, 1937, H. Townes (Townes).

Paratypes: ♀, Saranac Lake, N. Y., June 20, 1946, R. T. Mitchell (Mitchell). ♀, Foxborough, Ont., Sept. 9, 1934, H. G. James (Ottawa). ♀, Swansea, near Toronto, Ont., July 12, 1938, H. S. Parish (Townes). ♀, Swansea near Toronto, Ont., July 30, 1938, H. S. Parish (Townes). ♀, Thunder Bay Beach, Ont., May 29, 1939, H. S. Parish (Townes).

14. **Erromenus (Erromenus) nasalis,** new species

Figure 21

Clypeal foveae very large; seventh tergite of female with an apical, rounded, nose-like prominence that is covered with erect setae; male not easily distinguished from that of E. caelator or of E. planus.

Fore wing about 4.6 mm. long; second tergite rather coarsely punctate, mat with the apical 0.15 polished or sometimes the entire tergite more or less polished; seventh tergite of female apically much decurved and with a median apical nose-like hump that is covered with rather long upright setae (figs. 21 and 21A); ovipositor sheath about 0.8 as long as the subgenital plate (fig. 21). Agrees otherwise with the structural description of *E. caelator*.

Black. Mandible ferruginous, usually yellow medially; clypeus and palpi pale ferruginous, the basal 0.35± of the clypeus black; scape usually fulvous beneath; tegula yellow, postero-mesally pale ferruginous to brownish; legs ferruginous, the coxae and basal trochanters frequently black, piceous, or infuscate; tibiae each with a basal external yellow mark; apical 0.12 to 0.25 of first tergite and all of the following tergites ferruginous, in the males the second and third tergites sometimes with median basal infuscate areas and the apical tergites sometimes somewhat infuscate baso-laterally.

Type: ♀, just above Narada Falls (4700 ft.), Mt. Rainier, Wash., July 19, 1940, H. & M. Townes (Townes).

Paratypes: 7 ♂, ♀, collected with the type (Townes and Lawrence). ♀, Estes Park, Colo., July 11, 1934, A. L. Melander (Cambridge). ♂, Mt. Madison, N. H., June 24, 1938, H. & M. Townes (Townes). ♂, Connecticut Hill at 2095 ft., Tompkins Co., N. Y., June, 1937 (Townes). ♀, Millwood, N. Y., June 21, 1936, H. K. Townes (Townes). ♂, Poughkeepsie, N. Y., Aug. 20, 1936, H. K. Townes (Townes). ♀, Franklin Co., Ohio, Sept. 12, 1941, J. E. Gillaspy (Washington). ♀, Laneil, Que., July 13, 1932, H. S. Fleming (Ottawa). ♀, Alton, R. I., Sept. 18, 1937, M. Townes (Townes). ♀, Westerly, R. I., June 10,

1936, M. Townes (Townes). ♀, Westerly, R. I., June 27, 1946, M. Townes (Townes). 4 ♂, 7 ♀, Mt. Rainier, Wash., at 3800 ft., 4000 ft., 4200 ft., 4700 ft., and 5000 ft., July 7 to 22, 1940, H. & M. Townes (Townes). Since the males lack good diagnostic characters it is possible that some of the male paratypes are not correctly determined.

This species occurs across the continent in the Transitional, Canadian, and Hudsonian zones. The capture of specimens in Rhode Island from June 10 to September 18 indicates more than one generation a season.

15. **Erromenus (Erromenus) labratus,** new species

Face and clypeus very broad and nearly flat, the clypeus about 2.7 as wide as long; hind femur ferruginous.

Type female: Fore wing 5.2 mm. long; clypeus 2.7 as wide as long; cheek 0.12 as long as the basal width of the mandible; lower half of mesopleurum with moderately fine punctures separated by about 1.2 their diameter; front tarsal claws sparsely pectinate on their basal 0.3; combined basal area and areola 0.75 as long as wide; second tergite 0.6 as long as wide, with rather close medium sized punctures separated by about 1.2 their diameter. Agrees otherwise with the structural description of *E. tonto.*

Black. Clypeus light ferruginous, its basal 0.35 black; mandible and palpi yellow; apical part of scape fulvous below; tegula yellow, postero-mesally stained with ferruginous; legs ferruginous; front coxae brownish ferruginous basally, the rest yellow; middle coxa light brown basally, the rest yellow; hind coxa black, ferruginous apically and below; trochanters and apices of femora yellow; front and middle tibiae and tarsi very pale ferruginous; bases of all tibiae yellow; hind tibia and segments of hind tarsus brownish ferruginous, pale basally; apical margin of second to fourth tergites, apical 0.3 of fifth and all of following tergites, genitalia, and subgenital plate stramineous or pale fulvous.

Type: ♀, G. Alpine Cr., Tahoe, Calif., July 5, 1915, E. P. VanDuzee (Berkeley).

16. **Erromenus (Erromenus) tonto,** new species

Face and clypeus very broad and unusually flat, the clypeus about 3.0 as wide as long; hind femur black.

Fore wing about 5.5 mm. long; face rather weakly convex, medially with rather coarse punctures, sublaterally the punctures finer and dense, and laterally the punctures fine and sparser. Clypeus about 3.0 as wide as long, very weakly convex transversely, longitudinally convex in its basal 0.3 and the rest of its length flat; clypeal suture a furrow, deepened into a pair of small pits at the foveae; cheek about 0.14 as long as the basal width of the mandible; occipital carina reaching the hypostomal carina, strong and sharp at its juncture; lower half of mesopleurum with moderately fine punctures separated by about 1.4 their diameter; areolet present; front tarsal claws of male pectinate on their basal 0.25, of female the pectinations not clearly visible in the unique specimen at hand, but the claws apparently pectinate on their basal 0.3; combined basal area and areola of propodeum about 0.85 as

long as wide; petiolar area of moderate size, hexagonal, unusually smooth and usually with a weak median vertical carina; lateral section of apical carina unusually long, sloping slightly upwards from the petiolar area; second tergite of male about 0.77 as long as wide, of female 0.67 as long as wide; second tergite with rather fine punctures separated by about 1.5 their diameter; female with the sixth and seventh tergites telescoped within the fifth, the median half of the apical margin of the fifth tergite membranous, and the apical margin of the sixth and seventh tergites with short ventrally-projecting setae; ovipositor sheath almost flat, polished, about 1.0 as long as the subgenital plate. Agrees otherwise with the structural description of *E. variolae*.

Black. Clypeus light ferruginous, its basal 0.35 black; mandible white, black at the extreme base and dark ferruginous apically; palpi and tegula white; legs black, whitish as follows: lower part of front and middle coxae, first trochanters of front and middle legs except behind, second trochanters of front and middle legs, apex of first trochanter and more or less of second trochanter of hind leg, bases and apices of femora, ends and outer part of fore and middle tibiae, tibial spurs, and fore and middle tarsi, the middle tarsus often brownish apically; female with seventh tergite, ovipositor sheath, and subgenital plate light ferruginous; male with apical part of eighth tergite and of claspers more or less whitish.

Type: ♀, headquarters area of the Sierra Ancha Experimental Forest, Parker Creek, Sierra Ancha, Ariz., 5400 ft., April 24, 1947, H. & M. Townes (Townes).

Paratypes: 11 ♂, taken at the type locality by H. & M. Townes on April 19, 21, 24, 25, 26, 29, and May 2 and 7, 1947 (Townes). 13 ♂, Pocket Creek, Sierra Ancha, Ariz., May 5, 1947, H. & M. Townes (Townes). 6 ♂, Workman Creek, Sierra Ancha, Ariz., April 30, May 6 and 8, 1947, H. & M. Townes (Townes).[4]

This species seemed common among deciduous trees along the streams of the Tonto National Forest area at 5300 to 6200 ft. elevation.

17. **Erromenus (Erromenus) dolichops,** new species

Figure 18

Areolet absent; cheek about 0.6 as long as the basal width of the mandible; occipital carina not reaching the hypostomal carina, or weak at its juncture with the hypostomal carina.

Fore wing 4.8 mm. long; face longer than in other Nearctic species of the genus, medially with large indistinct punctures that are somewhat confluent, laterally almost impunctate; clypeus about 2.0 as long as wide, transversely strongly convex, longitudinally convex with a weak flattening beyond the middle; clypeal suture a broad furrow; clypeal foveae large and pit-like; cheek about 0.6 as long as the basal width of the mandible; lower half of mesopleurum with medium sized punctures separated by about 1.2 their diameter; lateral carina of

[4]These specimens are part of a lot of about 8,000 ichneumonids collected by the authors in Arizona with the aid of a grant from the Penrose Fund of the American Philosophical Society. Other Tryphonini in this lot of specimens are *Polyblastus tibialis*, *P. pedalis*, *Erromenus dolichops*, *Monoblastus montezuma* and *M. kaniacensis*.

scutellum extending 0.2 to 0.6 its length; areolet absent; petiolar area longer than wide, elliptical or somewhat elongate hexagonal; second tergite about 0.75 as long as wide, mat and rather coarsely punctate basally, subpolished and more finely punctate apically; apical tergites of female retracted and ovipositor sheath flat (fig. 18) as in *E. variolae;* apex of sixth and seventh tergites with moderately long ventrally-projecting setae. Agrees otherwise with the structural description of *E. variolae.*

Black. Clypeus and mandible dark ferruginous, the basal 0.3± of the clypeus black and the basal 0.2 to 0.6 of the mandible black or infuscate; palpi light brown or ferruginous to dark brown; tegula light to dark ferruginous; legs dark ferruginous, the coxae and trochanters typically black, but frequently more or less ferruginous; hind tarsus and apical part of fore and middle tarsi infuscate; hind tibia usually weakly infuscate apically and basally; abdomen varying from entirely ferruginous beyond the first tergite with the apical 0.12 of the first tergite ferruginous to mostly black, but with broad to very broad apical ferruginous margins on the second and following tergites, more or less continued forward along the sides. Frequently the tergites beyond the first are ferruginous with a large median basal semicircular black area.

There is a female from North Saugus, Mass., with the scape and pedicel fulvous and the flagellum strongly tinged with fulvous. Three males from Takoma Park and Bowie, Maryland, have the coxae and trochanters entirely ferruginous. A specimen from Gull Lake, Alta., one from Stoneham, Que., and three reared specimens from Abington, Conn., have the trochanters and coxae ferruginous but the coxae infuscate or black basally.

Type: ♀, just above Narada Falls (4700 ft.), Mt. Rainier, Wash., Aug. 17, 1940, H. & M. Townes (Townes).

Paratypes: ♀, taken with the type (Townes). ♂, ♀, Mt. McKinley National Park, Alaska, 1932, F. W. Morand (Washington and Townes). ♀, Gull Lake, Alta., June 14, 1929, E. H. Strickland (Townes). ♀, Oak Creek Canyon, Ariz., May 17, 1947, H. & M. Townes (Townes). ♂, Agassiz, B. C., July 6, 1927, H. H. Ross (Ottawa). ♂, Canal Flats, B. C., emerged Aug. 23, 1939, reared from "green tapered sawfly larva on *Larix occid.*," J. L. Johnson (Ottawa). ♂, ♀, Cranbrook, B. C., emerged July 26, 1939, reared from sawfly, C. Bloom (Ottawa). ♂, Cranbrook, B. C., emerged Sept., 1939, reared from sawfly, C. Bloom (Ottawa). ♀, Gold Creek, Cranbrook, B. C., emerged Aug. 7, 1939, from a small sawfly cocoon on *Larix*, F. H. Pym (Ottawa). 2 ♂, ♀, Abington, Conn., "5–9–21," reared from a tenthredinid (Washington and Townes). ♂, Churchill, Man., July 14, 1937, W. J. Brown (Ottawa). ♂, Bowie, Md., Oct. 9, 1943, H. & M. Townes (Townes). 2 ♂, Takoma Park, Md., Sept. 22, 1945, H. & M. Townes (Townes). ♂, Takoma Park, Md., Oct. 13, 1945, H. & M. Townes (Townes). ♀, Takoma Park, Md., Oct. 26, 1946, H. & M. Townes (Townes). ♀, North Saugus, Mass., May 25, 1907 (Townes). ♂, Oswego, N. Y., July 7, 1936 (Washington). ♂, 3 ♀, Jockvale, Ont., May 28, 1934, G. S. Walley (Ottawa). ♂, 2 ♀, Jockvale, Ont., June 1, 1935, "flying about green sawfly larva on aspen," G. S. Walley (Ottawa). ♀, Stoneham, Que., June 18, 1938, H. & M. Townes (Townes). ♂,

Prince Albert National Park, Sask., July 19, 1941, J. G. Rempel (Townes). ♂, Northbend, King Co., Wash., July 8, 1920, E. P. VanDuzee (San Francisco). 9 ♂, Mt. Rainier at 5300 ft., Wash., Aug. 15 and 17, 1940, H. & M. Townes (Townes and Lawrence). ♂, Westport, Wash., July 17, 1940, H. & M. Townes (Townes).

This species ranges across the continent in the Transitional, Canadian, and Hudsonian zones. It occurs among shrubs where it appears to be parasitic on a variety of Tenthredinidae. Adults are on the wing from spring to well into the fall, indicating several generations a season.

18. **Erromenus (Erromenus) variolae,** new species

Clypeal suture absent; clypeus flat in profile; hind femur infuscate to blackish; occipital carina not reaching the hypostomal carina, or weak at its juncture with the hypostomal carina.

Fore wing about 4.8 mm. long; face rather evenly convex, most protuberant just below the antennal sockets, medially with deep coarse confluent punctures, sublaterally with punctures somewhat smaller and not confluent, laterally with a few weak punctures; clypeus about 2.5 as wide as long, transversely convex and longitudinally flat; clypeal suture not distinctly indicated between the foveae, the clypeus medially separated from the face only by its practical lack of punctation; clypeal foveae large and pit-like; cheek about 0.3 as long as the basal width of the mandible; occipital carina not quite reaching the hypostomal carina, or if reaching it weak or indistinct at the juncture; lower half of mesopleurum with medium sized punctures separated by about 1.0 their diameter; hind part of mesoscutal margin elevated as a lamina about 0.3 as high as the tegula is wide; lateral carina of the scutellum extending about 0.3 its length; areolet usually present (present in the type and in two of the three paratypes); front tarsal claws sparsely pectinate on the basal 0.45 in the male and on the basal 0.65 in the female; combined basal area and areola of the propodeum about 1.1 as long as wide; petiolar area rather small, somewhat longer than wide, roundly hexagonal with its top side flattened or somewhat concave, without or with a weak incomplete median vertical carina; lateral section of apical carina unusually long and sloping upwards from the petiolar area; dorsal carinae of first tergite sharp and strong, ending 0.15 to 0.25 from the apex of the tergite; second tergite about 0.78 as long as wide, polished, with close medium sized punctures basally and more distant finer punctures apically; in the female the sixth tergite projecting little if any beyond the fifth, the seventh tergite capable of being completely retracted within the sixth so that only its apical margin is visible and the apex of the abdomen is hollowed out and lined mostly with intersegmental membrane (as in *E. dolichops*, fig. 18); apex of sixth and seventh tergites with very long, curved, ventrally projecting setae; ovipositor sheath about 0.8 as long as the subgenital plate, broad, flat, elliptical but somewhat upcurved (as in *E. dolichops*, fig. 18).

Black. Apical 0.65 of clypeus pale ferruginous; apical 0.4 to 0.65 of mandible dark ferruginous; palpi pale ferruginous; under side of scape and flagellum more or less ferruginous; tegula yellow, mesally stained

with ferruginous; fore coxa infuscate ferruginous, paler apically; middle coxa piceous; hind coxa black; basal hind trochanter brownish ferruginous; apices of fore and middle femora and a basal section of all tibiae pale yellow; hind femur pale brown to blackish, pale at the base and apex; hind tibia infuscate except basally, darkest towards its apex; hind tarsus fuscous; the rest of the legs ferruginous; first tergite medially and second and third tergites except laterally with the apical margins narrowly fulvous.

Type: ♂, Lawrence, Kans., May 23, 1941, H. Townes (Townes).

Paratypes: ♂, Chesilhurst, N. J., June 3, 1939, H. Townes (Townes). ♂, Ithaca, N. Y., May 15, 1936 (Townes). ♀, Dixie Landing, Va., May 27, C. L. Marlatt (Washington).

The specimen from Chesilhurst, N. J., was collected among scrub oak and *Vaccinium* bushes.

Subgenus **Aderaeon,** new subgenus

Figure 17

Type: *Erromenus bedardi* as identified here.

Clypeus with its lateral apical parts weakly impressed, otherwise rather flat; epomia short, weak, and indistinct, not extending below the pronotal sulcus; anterior half of subtegular ridge somewhat concave and distant from the tegula, the ridge capable of touching the tegula only at its middle (fig. 17); tarsal claws apparently not pectinate; basal angles of first tergite very strong; sixth and seventh tergites of female long, each projecting strongly beyond the preceding tergite; subgenital plate of female very long; ovipositor sheath without setae, very small, about 0.3 as long as the subgenital plate.

This subgenus contains only one species, described below.

19. **Erromenus (Aderaeon) bedardi** Provancher, new combination

Figure 17

Erromenus Bedardi Provancher, 1879. Nat. Canad. 11: 266; Faune, p. 424. Type: ♀, Douglastown, Que. (Quebec).

Fore wing about 6.0 mm. long; face somewhat convex, bulging just below the antennal sockets, its punctation dense and rather coarse medially, somewhat sparser and finer near the sides; clypeus about 2.2 as wide as long, transversely weakly convex, longitudinally very weakly convex, its lateral apical areas somewhat impressed; clypeal suture a furrow; clypeal foveae rather large abrupt pits; cheek about 0.5 as long as the basal width of the mandible; occipital carina reaching the hypostomal carina, strong and sharp at the juncture; lower half of mesopleurum with moderately fine punctures separated by about 1.2 times their diameter; hind part of mesoscutal margin elevated as a lamina about 0.25 as high as the tegula is wide; scutellum with lateral carinae only at its basal corners; areolet lacking; combined basal area and areola of propodeum about 0.8 as long as wide; petiolar area large, angularly hexagonal, the upper side broadened and more or less concave, without a median vertical carina; lateral section of apical carina rather long, horizontal; dorsal carinae of first tergite exceptionally high and heavy, ending at the apex of the tergite and continued weakly on to the

basal 0.4 of the second tergite as lateral margins of a median subbasal swelling; second tergite about 0.6 as long as wide, with a pair of broad weak oblique furrows that demark its lateral basal corners to slightly beyond the level of the spiracles, entirely densely and strongly rugulose and mat; ovipositor sheath very small, slender, weakly upcurved, and tapered evenly to its sharp slender apex.

Black. Mandible and tegular dark ferruginous; apical 0.7 of clypeus, the palpi, and the legs ferruginous; under side of scape often more or less ferruginous.

Specimens: ♀, McLeod Meadow, Kootenay Park, B. C., reared from *Pikonema* sp., July 17, 1936, H. Richmond (Ottawa). ♀, Gloucester, N. B., reared from *Pikonema dimmockii*, April 17, 1939 (Ottawa). ♀, Madawaska Co., N. B., reared from *Pikonema alaskensis*, Feb. 27, 1940 (Ottawa). ♀, Northumberland Co., N. B., reared from *Pikonema alaskensis*, Mar. 17, 1941 (Ottawa). ♂, Halifax Co., N. S., reared from *Pikonema alaskensis*, Mar. 20, 1941 (Ottawa). ♀, Franz, Ont., reared from *Pikonema alaskensis*, April 5, 1939 (Ottawa). ♀, Grant, Ont., reared from *Pikonema dimmockii*, Mar. 3, 1938 (Ottawa). ♀, Heron Bay, Ont., reared from *Pikonema dimmockii*, April 2, 1939 (Ottawa). ♀, Massey, Ont., reared from *Pikonema alaskensis*, Mar. 31, 1939 (Ottawa). ♀, North Bay, Ont., reared from *Pikonema dimmockii*, Mar. 6, 1938 (Ottawa). ♀, Skead, Ont., reared from *Pikonema dimmockii*, Mar. 7, 1938 (Ottawa). ♀, Swastika, Ont., reared from *Pikonema dimmockii*, Mar. 7, 1938 (Ottawa). ♂, Canton Albert, Que., reared from *Pikonema dimmockii*, June 2, 1941 (Ottawa). 4 ♂, 2 ♀, Cascapedia River, Que., reared July 1 to 15, 1935, M. L. Prebble (Ottawa and Washington). ♂, Gracefield, Que., June 10, 1937, O. Peck (Ottawa). ♂, Riv. aux Outardes, Que., reared from *Pikonema dimmockii*, Feb. 2, 1941 (Ottawa). ♀, St. Raymond, Que., reared from *Pikonema alaskensis*, Mar. 29, 1939 (Ottawa). ♀, Wright, Que., June 29, 1935, G. S. Walley (Ottawa). ♂, Que., incubator reared from *Pikonema dimmockii* (Ottawa). ♀, reared from *Pikonema dimmockii*, Feb. 22, 1937 (Ottawa).

This species appears to occur in the Canadian Zone from the Atlantic to the Pacific. Rearing records indicate it to be parasitic exclusively upon species of *Pikonema*, a genus of Tenthredinidae restricted to *Picea*. Only two individuals among those reported above were collected in the wild, taken at Gracefield and Wright, Que., on June 10 and June 29, respectively. Seven reared specimens emerged from July 1 to July 15, probably during a natural emergence period. The other emergences, all in February, March, and April, were doubtless affected by a laboratory climate.

BOOK NOTICE

THE BLOWFLIES OF NORTH AMERICA, by DAVID G. HALL. 477 pages. Numerous illustrations. Price, $6.50. The Thomas Say Foundation. Send orders to Professor J. J. Davis, Purdue University, Lafayette, Indiana.

Seldom does a book command the respect and admiration which this one elicits. It is obviously the result of labor of love over a long period of years and this labor has resulted in useful information often needed by entomologists and others concerned with the health of man, domesticated animals, and wildlife. This information consists of keys for the identification of North American blowflies and knowledge of their classification, life histories, habits, geographic distribution, and control. So much new material appears for the first time that this reference book is necessary if one has to deal with the subject it treats.

The systematic account of the Calliphoridae of North America includes all known species which total 83 in 27 genera. Fifteen of these species and 6 genera are described as new. There are, as could be expected, many new combinations of names; thus the screwworm fly becomes *Callitroga americana* and the secondary screwworm fly *Callitroga macellaria* (apparently the recognition of an old combination), and *Lucilia sericata* becomes *Phaenicia sericata*. It is surprising to learn that *Lucilia caesar* has apparently never been taken in North America and what American entomologists have called by that name is usually *Lucilia illustris* (Meigen). The bird nest screwworm flies are placed in a new genus, *Apaulina*. Changes in names are deplored by those of us who have to learn the new names but there appears to be no other way to correct errors and to arrive at a better understanding of classification.

The abundance of keys and the detailed descriptions are rivaled by the splendid illustrations. Dr. Hall is well known as an illustrator of insects. There are five colored plates, each of an adult fly, nine figures in the text mainly of internal anatomy of adults and examples of myiasis, and forty-six plates each having several figures of heads and genitalia of adults or cephaloskeletons and spiracles of larvae. The detailed illustrations of larvae are particularly welcome and are worth the price of the book for anyone having to identify maggots in this family. There are twelve pages of references and an index of eleven pages.

A contribution of this order is regularly an impetus to additional studies. In this connection it is of interest that the author points out that there are probably many species to be discovered and that the biologies and immature stages of a majority of the species remain to be discovered.

The binding and printing is of excellent quality.—C. VENARD.

"The Blowflies of North America" is truly a work of love. As a student and a companion in the field we have known David G. Hall from his initiation into entomology by James Hine (Daddy Hine). Hall started out as a student of art in Cleveland. He was fascinated by insects. On a week-end trip he collected across Professor Hine's fruit farm in the Cleveland district. Hine recognized the intense interests of his trespasser and suggested that he study entomology at Ohio State University. Hine fascinated Hall and Hall worshipped Hine, who had opened the double door to emotional art and exacting science. A devotee had been recognized and reclaimed. Hall's father was a successful minister. We have known other eminent biologists who were natural artists, honest clear-minded scientists and who were fortunate enough to have been guided mentally by a sincere, religious father. Luck was with Hall from birth. Hine gave Hall the opening and early guidance. Later Aldrich gave Hall every assistance available. Such is the continuing guidance of good teachers down through time.

"The Blowflies of North America" is a work of love! Its exacting standards on every page of print and in every illustration, a work of many years, show it to be outside of and above any thought of lengthy personal bibliography or elevation in rank and salary.

Professor Venard has generously helped us with a technical diagnosis. We do not know Diptera beyond the bloody attacks of *Chrysops*, double chins from black flies and the irritating punctures of mosquitoes.—C. H. KENNEDY.

NOTICE TO MEMBERS AND CONTRIBUTORS

The Annals of the Entomological Society of America, published by the Society quarterly, includes the Proceedings of the Annual Meetings and such papers as may be selected by the Editorial Board.

Papers may be submitted to any member of the Editorial Board and should be as nearly as possible in the form desired as final, typewritten, and illustrations finished complete ready for reproduction. Plates must not exceed 4¼x6¾ inches unless intended to fold. Cuts for illustrations are charged at cost to the author. In general, papers to be accepted must be original, complete and previously unpublished. Authors will be allowed fifty reprints gratis and additional copies at cost to the Society.

The Managing Editor is provided with the most recent address of all paid-up members on record in the Secretary's office for mailing the numbers of the Annals and members failing to receive their numbers should present their complaint to the Managing Editor within four months from the date of the mailing of the issue. After that time the numbers will be furnished only at the regular published rate.

Requests for information as to membership and annual dues of members should be sent to the Secretary-Treasurer, Dr. Herbert H. Ross, Illinois State Natural History Survey, Urbana, Ill.

Communications relating to the Annals, and orders for reprints, should be addressed to the Managing Editor.

SUBSCRIPTION RATES AND BACK NUMBERS

The regular subscription rate for the ANNALS is $6.00 (U. S. money) in the United States and all other countries.

Subscriptions from non-members, and orders for back numbers, are now being handled through the Columbus office. Letters should be addressed to Mrs. Helen S. Lanman, Dept. of Zoology and Entomology, The Ohio State University, Columbus 10, Ohio.

The stock of back numbers of the ANNALS is now in charge of The Spahr & Glenn Company, 50 East Broad Street, Columbus 15, Ohio, by whom all shipments will be made, but orders should be addressed to Mrs. Helen S. Lanman as above.

Back numbers are furnished at the following prices: Volumes 1 to 31, $4.00 per volume, $1.00 per issue; Volumes 32 to 38, $5.00 per volume, $1.25 per issue; Volumes 39 to 41, $6.00 per volume, $1.50 per issue.

THE THOMAS SAY FOUNDATION

Vol. I.—*Sarcophaga and Allies of North America* . . Price, $3.00
By J. M. ALDRICH

Vol. II.—*Plecoptera or Stoneflies of North America* 5.00
By J. G. NEEDHAM and P. W. CLAASSEN

Vol. III.—*Plecoptera Nymphs of North America* 4.00
By P. W. CLAASSEN

Vol. IV.—*The Blowflies of North America* 6.50
By DAVID G. HALL.

Members of the Entomological Society of America will receive a ten percent discount on volume IV, if the purchase is a personal one.

Send orders to J. J. DAVIS, Purdue University, Lafayette, Indiana.

Orders outside the United States, Canada, Mexico and U. S. Possessions, 50 cents extra per volume.

All accounts with the Entomological Society of America, or its Journal, "The Annals," owing by individuals or institutions without the United States should be paid by Postal Money Order in American Dollars.

CONTENTS OF THIS NUMBER

PAGE

ATKINS, E. LAURENCE, JR.—A Study of the Ptilinum and Ptilinal Musculature of the Pomace Fly, *Drosophila melanogaster* Meigen (Diptera, Drosophilidae)..... 245

MICHENER, CHARLES D.—A Revision of the American Species of *Diceratosmia* (Hymenoptera, Megachilidae)..... 258

HEADLEY, A. E.—A Population Study of the Ant *Aphaenogaster fulva* ssp. *aquia* Buckley (Hymenoptera, Formicidae)..... 265

FRACKER, S. B., AND USINGER, R. L.—The Generic Identification of Nearctic Reduviid Nymphs (Hemiptera)..... 273

RICKER, WILLIAM E.—The North American Species of *Paragnetina* (Plecoptera, Perlidae)..... 279

JENKINS, DALE W.—Trombiculid Mites Affecting Man. IV. Revision of *Eutrombicula* in the American Hemisphere..... 289

JOHANSEN, CARL—*Meteorus argyrotaeniae*, a New Species of Braconidae Parasitic on the Orange Tortrix..... 319

TOWNES, HENRY K., AND TOWNES, MARJORIE C.—A Revision of the Genera and of the American Species of Tryphonini (Hymenoptera: Ichneumonidae). Part I..... 321

Book Notices.....278, 318, 320, 396

PRINTED IN THE UNITED STATES OF AMERICA
THE SPAHR & GLENN COMPANY, COLUMBUS, OHIO